A NEW TEXTBOOK FOR NURSES IN INDIA

Vol. I

Fourth Edition

The Foundations of Nursing

History of Nursing

Nutrition and Diet Therapy

Microbiology

The Board of Nursing Education Nurses League
Christian Medical Association of India
(South India Branch)

A NEW TEXTBOOK FOR NURSES IN INDIA

Volume I

THE FOUNDATIONS OF NURSING

FOURTH EDITION

CHRIST THE GREAT HEALER

A NEW TEXTBOOK FOR NURSES IN INDIA

Volume 1

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THE BOARD OF NURSING EDUCATION NURSES LEAGUE
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THIS BOOK IS DEDICATED TO THE NURSES OF INDIA

THE NIGHTINGALE PLEDGE

I SOLEMNLY pledge myself before God and in the presence o this assembly to pass my life in purity and to practice m profession faithfully. I will abstain from whatever is deleteriou and mischievous, and will not take or knowingly administer ar harmful drug. I will do all in my power to maintain and elevat the standard of my profession and will hold in confidence a personal matters committed to my keeping and all family affai coming to my knowledge in the practice of my calling. Wit loyalty, I will endeavour to aid the physician in his work, an devote myself to the welfare of those committed to my care.

FOREWORD

Third Edition

THE Board of Nursing Education of the Nurses' League, CMAI (South India Branch) is to be congratulated for undertaking once again a task which will contribute appreciably to the preparation of good nurses.

As medical science is advancing continually both in its preventive and curative aspects, it is essential, as it has always been, for nurses to keep abreast with new knowledge. The publication of a third revised edition of a New Textbook for Nurses in India, Vol. I will, therefore, be widely welcomed by nursing schools. The second edition has been reprinted nine times which is a measure of the demand for this comprehensive text which covers all factors that make for good nursing practice applied to Indian conditions.

The new edition will also be a useful reference book for trained nurses and help in maintaining the high standard of nursing practice which has been a distinguishing mark of mission hospitals.

31st July 1986 T. K. ADRANVALA

FOREWORD

Second Edition

NURSING tutors and nursing students everywhere in India will welcome a new edition of Volume I of the popular *A New Textbook for Nurses in India*. This edition has been thoroughly revised, and new material has been added to bring it up-to-date with current developments and practice.

The South India Examining Board of the Nurses' League, C.M.A.I., has played a significant role in developing nursing education and in setting a high standard of nursing practice. One of its most valuable contributions to nursing has been *A Textbook for Nurses in India*, printed in 1941 at a time when scarcely any books had been written for nurses in India. The Textbook was translated into three languages and has been widely used. In the late fifties the text was re-written, and Volume I of *A New Textbook for Nurses in India* was printed in 1961. The Textbook Committee of the Board are to be congratulated on completing another revision. Nurses will appreciate the magnitude of the work undertaken by the members, knowing that each one is already carrying a full-time job.

I am sure that the new edition will be in much demand and will contribute appreciably to the training of good nurses.

T. K. ADRANVALA
Formerly Nursing Adviser
Directorate General of Health Service

PREFACE

FOURTH EDITION

It had been 39 years since the First edition of this textbook was completed. The authors have tried to strike a balance between the existing new development and the vast quantity of established facts that need to be absorbed by the students of today. They have also tried to produce a detailed yet comprehensive text that bridges the gap between the purely introductory and the larger reference works. The aim throughout in the preparation of this present editon was to ensure that it is factually correct and upto-date. Changes have been made in many chapters and a few new chapters have been added.

Many friends and colleagues have aided us in our efforts over the years and it is impossible to cite the numerous ways in which we are indebted to them.

We are sincerely grateful for the invaluable assistance we have been fortunate to have. The insight and encouragement of all our predecessors have supported us on our journey as this book has grown from a dream to a reality and now into the 4th edition.

Welcome to a most rewarding source of information !

20th July 2000

Mrs. Lalitha Varghese
Secretary-Treasurer
Board of Nursing Education
NL CMAI (SIB)

PREFACE

THIRD EDITION

The Third edition of the first volume of *A New Textbook for Nurses in India (Foundations of Nursing)* has been prepared with great effort to meet the needs of Nursing students of today. Great effort has been made to expand certain portions and to cut down irrelevant portions. Many chapters have been rewritten.

The initial plan for the four volumes to this Textbook has been changed. Instead separate books on *Fundamentals of Nursing (A New Textbook for Nurses in India, Vol. II), Community Health Nursing, Professional Adjustment, Ward Management* have been published. Textbooks on Medical, Surgical, Nursing and Psychology are being prepared and will be published soon.

The preparation of this edition has required the efforts of many persons. Grateful acknowledgement is made of the effort of Mrs. Violet Jayachandran as Chairman of the revision committee, each contributing author and staff of the College of Nursing, Dietic Department and Microbiology Department of CMC Hospital, Vellore.

K.V.ANNAMMA

Editor

PREFACE

SECOND EDITION

The first volume of *A New Textbook for Nurses in India* has been in great demand by nursing students, graduate nurses and teachers during the past years. However, knowledge and understanding based upon scientific principles have changed rapidly in both medicine and nursing since 1961. The Second Edition has been prepared with an effort to eliminate information and concepts of theory and practice which are no longer applicable in nursing and to add those which are now being practised, especially in India. It is hoped that this volume will help to meet the intense need felt by both nursing students and educators.

The initial plan for the four volumes to this Textbook remain the same as given in the Preface to the First Edition. The Second Edition was prepared in the same manner with contributing authors making revisions of each section and an editor correlating the material. The remaining three volumes are in the process of being prepared.

The preparation of this edition has required the efforts of many persons. Grateful acknowledgement should be made to each contributing author and each member of the Textbook Committee of the Examining Board, Nurses' League of the Christian Medical Association of India, South India Branch. Gratitude should also be expressed for the valuable assistance and advice given by the staff of the Dietary Department, C.M.C. Hospital, Vellore, The Christian Literature Society and The Wesley Press.

ANN J.ZWEMER

Editor

PREFACE

FIRST EDITON

The Writing of this textbook has been undertaken in response to the often expressed need for something more advanced and more comprehensive than *A Textbook for Nurses in India,* first put out by the South India Examining Board of the Nurses' Auxiliary of the C.M.A.I. in 1941 and 1951. Many factors have contributed to this need.

There is the obvious need for a text to fit the Indian situation. Many applications of general nursing and scientific principles to the Indian situation are quite different from those in foreign countries where the climatic, cultural, religious and social backgrounds differ greatly from those in India. Indian students need help in applying these principles to the problems faced in their own country. They need to know the history of nursing in India and the progress and future planning for the health of their own nation.

Another factor which has crystallized the realization of the need for a specially written text has been the lowering of the standard of English comprehension since the high school subjects are no longer taught in the English medium. The amount of content to be taught has been much increased but the student's ability to understand the English language has been considerably decreased, creating a serious problem in teaching. It was therefore felt that a new text was required which would be written in simple English which students could read and understand but which would at the same time meet the higher standards required of students in Higher Grade nursing schools.

Further the trend toward the use of the mother tongue for instruction in schools has made clear the need for looking into the future. It is likely in the foreseeable future that nursing instruction will also be in the local language. A text in simple English will be ready then for translation into the regional languages of the various areas.

Perhaps the most pressing need arises from the much enlarged syllabus of the Indian Nursing Council prepared for use in all nursing schools in India. This includes many subjects not in the previous syllabi of the Examining Board and emphasizes many new aspects of nursing care in line with new concepts of total nursing care and of the importance of public health and preventive health measures.

Yet it will be noticed, that not all parts of the syllabus have been included in this text since other books have recently been published or are in the process of being written on some of these subjects. However, a more complete coverage has been given to the subject of *Nutrition*, a knowledge of which is so vitally essential for the improvement of the health of India's peoples. The psychological and social aspects of nursing will be found as a thread running through the entire content of the text. Health teaching is integrated into all aspects of patient care.

The plan followed for the previous textbook, of having different contributors write sections of the book and of having an editor responsible for correlating these parts into the whole, has been followed in the writing of this text also.

The general principles agreed upon as a guide to all contributors were as follows:

1. That all the material should be realistically practical from the student's point of view, usable in small as well as in larger hospitals and applicable to the India situation.

2. That all aspects of nursing be applied to the care in the home as well as in the hospital.

3. That each unit should include a study guide with questions for students' use and references to other texts and professional magazines.

4. That the language be the simplest, both in structure and vocabulary.

For ease in handling and to facilitate the early printing of part of the text, it has been divided into four volumes. As each volume is completed it will be published as a separate unit of the whole. The four volumes will be as follows:

Volume I - History of Nursing, Nutrition, Cookery, Diet Therapy, Microbiology.

Volume II - Personal and Environmental Hygiene, Public Health, Professional Adjustments, Ward Management.

Volume III - Principles of Nursing Care including Drugs and Solutions.

Volume IV - Materia Medica, Application of Nursing care principles to patients with special needs.

This text has been written primarily for student nurses to help them to do better nursing by learning to think and to apply their knowledge. It is however the hope of the writers that it will also be used by graudate nurses and teachers. But the latter must realise that the text has not been written in the order in which it will necessarily be taught, neither does it completely cover the Indian Nursing Council syllabus and therefore cannot be considered as an examination guide.

It is hoped that the series as it is completed will meet the needs which stimulated its inception and may serve to advance the progress of nursing education in India.

Grateful mention should be made of the whole-hearted co-operation of all contributing authors who, while carrying on full-time work, have given their limited free time and vacations to make this book possible.

Special acknowledgement should be made of the invaluable help and suggestions given by Miss. V.K.Pitman who carried on the editor's work during my furlough and whose experience in working on the previous text made her assistance the more appreciated.

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PART I

HISTORY OF NURSING

CHAPTER 1

INTRODUCTION

Nursing as an art to be cultivated and a profession to be followed is modern; nursing as a practice originated in the dim past where some mothers among the cave dwellers cooled the forehead of her sick child with water from the brook ...

SIR WILLIAM OSLER

Why a historical background?

The word history brings to our mind a chronological record or account of past events and development. But the study of history of nursing is not just learning all the dates of historic events. It is to understand the changes that occurred in terms of religion, economy and politics in the various cultures of the world through the ages and how these changes influenced nursing and brought it to the present day status of a profession.

The needs of society either in India or abroad are changing constantly. Such changes have contributed to the many phases the nursing profession has passed through. Thus knowledge of general history is necessary as a basis to understand and interpret the changes which have taken place in nursing.

Nursing is not a product of modern medicine in the sense that social service and dietetics are. It should be remembered that medicine and nursing had independent origins and existed as such for many centuries without much contact. The reason was that the practice of medicine and surgery was very simple and undeveloped and therefore needed no technical skill.

During the centuries known as the Middle Ages, nursing was carried out by religious or military groups whose prime function was other than nursing care, as we understand today. They cared for the poor and destitute. The nursing needs, of the sick at home, were met by members of the family. It was the evolution of medicine, surgery and public health into complicated technical area requiring many

procedures to be performed by persons specially trained and havin understanding of scientific principles which brought the tw professions closer together. In fact, the need arose for an entirely ne group of persons who, in co-operation with the physician, could ten to the sick and carry out many procedures. Fortunately, by the tim the demand became urgent, reforms in nursing were started by nurse themselves, stimulated by changing social demands and conditions

Nursing, as a profession, has made its greatest progress in countrie where women have had freedom to live their own lives. Th emancipation or freeing of women is therefore of the utmos importance to the progress of Nursing. Since independence and th setting up of India's new Constitution, giving women equal politica economic and educational rights, we have seen larger numbers o young women coming forward to take up this profession.

This study of the development of nursing will help us to see som of the problems of the past, how they have been met, what ha hindered or prevented and what has helped in its development. W will be stimulated as we study about those who have worked to mak nursing what it is today. As we realise the high purpose, which we ar to serve, we should be inspired to accept our share of responsibilit for the future of nursing.

CHAPTER 2

THE GENESIS OF NURSING

Primitive ideas about diseases

Ancient history reveals no records of nursing in pre-historic times. What we know about the care of the sick in primitive times has been discovered through myths, songs and the findings of Archaeologists[1]. Pre-historic man's interest was in the mysteries of life, birth, disease and death. His life was very simple and he made few changes except when compelled to do so. He lived close to nature and soon associated spiritual values to all natural objects, believing that a thing in nature like a tree or river had a spirit or soul. Such a religion is known as Animism. Things in nature became friends or foes according to man's ability to control them. Water and trees were friends while storms and poisonous plants were enemies. This led to a form of worship. They thanked friendly things for their help and tried to make peace with the unfriendly.

Diseases appeared to be associated with sorcery, magic, breaking a taboo and bodily invasion by a spirit. It was necessary to find solution to free the body from the influences of evil spirits. To get rid of these evil spirits dwelling in the body, the body had to be made unpleasant for them. Thus starving, beating and nauseous medicines were used. Loud noises, magic rites and ceremonies and sudden fright were also tried. If the evil spirit was thought to live in a special part of the body, holes were made to allow it to escape. In the excavated graves of pre-historic man, skulls with holes made by trepanation[2] have been found.

The *medicine man* was one who paid close attention to signs and symptoms and thus knew what to do in some conditions. He attracted attention by wearing strange costumes, using magic words and queer procedures. As his influence increased, he took up the role of priest, pretending to understand and control the forces of health and disease. In this role he was known as the *priest-physician*. His word was law.

White magic was used to attract good or helpful spirits while black magic was used to drive away evil spirits or to bring harm to one's enemies. From their belief in evil spirits they soon came to think that disease was caused by their failure to please the Gods or due to their sin. This idea still exists, even among highly civilised intelligent people.

Primitive man's skill in fighting disease has given us many medical and surgical treatment, such as massage, fomentation, trephining, bone setting, amputations, hot and cold baths, abdominal sections, and heat to control haemorrhage.

Role of the Nurse in the care of the sick

From the time of the first mother down to the present time we find women protecting and caring for their children, aged and the sick members of the family. Nursing evolved as an intuitive response to the desire to keep healthy as well as to provide comfort to the sick. This was reflected in the caring, comforting, nourishing, and cleansing aspects to the patient. Knowledge of these simple skills was passed down from generation to generation. Tenderness, concern, love and hope were expressed in the simple remedies. Thus *empirical practices in nursing evolved.

Summary

The *art of healing* began thousands of years ago with the primitive man trying to provide relief in sickness and suffering motivated by feelings of sympathy and kindness.

The causes of diseases he thought were the anger of Gods, invasion of the body by evil spirits and bad influence of stars and planets.

The medicine he practised consisted in pleasing Gods by prayers, rituals and sacrifices; driving out evil spirits from the human body by noise or violence and using charms and amulets to protect himself against them. Medicine was intermingled with superstition, religion, magic and witchcraft. The practices of primitive medicine are still practised in many parts of the civilised world today.

In the most primitive setting, the nurturing efforts and independent role of the nurse in response to survival needs were

directed towards keeping people healthy as well as comforting the sick, resulting in empirical practice.

QUESTIONS FOR STUDY

1. What did primitive man think was the cause of disease?
2. What were some of the earliest methods of treatment?
3. What were the 3 solutions to get rid of evil spirits from the body?
4. What was the role of the 'medicine-man'?
5. Who was the first nurse? Give examples of some empirical practices of those days.
6. Are people today influenced by superstition? Give several examples.

[1]Archaeologist----one who studies ancient societies
[2]Trepanation----cutting a circular hole with a saw

CHAPTER 3

INFLUENCE OF ANCIENT CULTURAL PRACTICES ON HEALTH CARE

Introduction

After the prehistoric period, writing was invented. Archaeological findings and Bible presentations help us to study the contributions of the ancient cultures. History has been recorded on inscriptions, tablets, papyri, books and case histories. Community living changed from tribal groups to urban settlements. What role did disease play in the disappearance of these ancient civilised groups? It is thought that water must have been the cause of spread of disease because of its use for drinking, bathing, washing clothes, swimming, religious rituals and disposal of human and animal waste.

For centuries Egypt has been considered the earliest site of civilisation until two excavations were discovered at Mesopotamia.

SUMERIANS

When the Sumerians moved into the land between the Rivers Tigris and Euphrates, they had developed a system of writing, a set of laws and an advanced culture. Archaeologists have found evidence of the advanced craftsmanship, the medical skill and the burial customs of these people, who lived some five thousand years ago.

The excavation of the grave of Queen Shubad unearthed the jewels and gifts made of gold, silver and copper worn by the queen and buried with her. All her maids, servants, soldiers and court musicians were murdered while standing in position at her coffin and buried with her so as to accompany the queen to the next world. They worshipped evil spirits as Gods and built temples to them hoping to please them so that disease and misfortune would be eradicated. Thus the Medicine man became the Priest-physician who stayed in the temple. We find Medicine changing from witchcraft to craft.

The world's oldest known medical prescription scratched on a 400-year-old clay tablet was translated in 1953. The ancient physician wrote the remedies on this tablet but did not write the names of diseases.

BABYLONIANS (BABYLONIA -PRESENT IRAQ)

Babylon was a Mesopotamian empire. The people here worshipped Bel, later called Marduk, who was identified with the planet Jupiter. Bel was a cruel God who frequently craved for human blood in return for his favour. Children and handicapped members of the society were offered as sacrifices to this God. Hammurabi, the king of Babylonia, has been remembered for his Code of Laws. He tried to prevent the sufferings of the helpless and to reduce the cost of the medical care. Doctors were responsible to the Government and they were severely punished for their wrong treatments. The Priest-physician was given a higher place than a surgeon was.

Medical treatment was primitive. They believed that illnesses were caused by sin and anger from God. Temples became centres for medical care.

They brought their sick to the road and obtained advice on diagnosis and treatment of diseases. Principal methods of treatment consisted of giving bitter concoctions in order to drive away the evil from the sick.

An animal was kept near the sick person so that the devil could enter into it, then the animal was killed. 'Hepatoscopy' or the inspection of the liver of this animal was done, because liver was thought to be the source of blood and residence of soul. By inspecting the liver, the priest-physician could communicate with the mind of God.

Team approach was used to treat the sick person. The physician directed the treatment, the nurse carried out the care, and the pharmacist prepared the medicine and the spiritual care was administered along with these.

PERSIANS (PERSIA - PRESENT IRAN)

The Persians were a group of Iranian tribes. Cyrus the great became the leader of the Medes and Persians (550 B. C.). The religion centred

on the teaching of the prophet Zoroaster. Zoroastrianism is st practised in Iran and in India by the Parsees who are descendants the Persians.

They believed in the evil spirit theory of disease and practise spiritual assistance for cure of illness. Their Holy book, the *Aves* contained the ceremonial rules relating to the natural laws of birt and death. Principles of public health and sanitation were stressed i Zorastrian Medical laws and practices. They played music in order t cure illness. After a person's death his body was fastened to the ro of a special high tower called *Tower of Silence*. Birds picked the fles and bones dropped into the pit below.

Three types of practitioners came out of their medical centres: those who healed with the knife, those who healed with herbs an those who healed with holy words.

ANCIENT EGYPT

The oldest medical records we have, come from Egypt. They dat back to 1600 B. C. The records were written on papyrus paper and hav been preserved in Egypt's hot, dry sands. One of the best known c these was brought in 1874 by Dr. Ebers of Germany. It is known a Eber's Papyrus. It contains descriptions of diseases, surgery and drugs Many of the prescriptions contain numerous drugs. Some of thes drugs, such as, dill, caraway and myrrh are known today. Othe prescriptions contained such ingredients as, 'Blood of a bat' or ' fat o a mouse', showing that superstition and magic were practised.

Medicine was thought to be divine origin. One outstanding priest physician was Imhotep, -- which means 'He who cometh in peace'. H was so well liked because of his kindly personality and his success i healing the sick that, after his death, the people elevated him to th rank of God. Temples were built to protect their Gods. To these temple people came for healing.

The early Egyptians believed in 'life after death' as long as th soul remained in the body. Thus they developed the art of embalmin and bandaging the body to preserve it. Such an embalmed body wa known as a 'mummy'. This art of embalming is not known today. From

these preserved bodies, medical knowledge, regarding diseases which existed at that time and their treatment, has been gained.

Women in Egypt had no career but had some freedom. The mother had a position of authority. Women of high rank became priestesses in the temples. Some have assisted the priest-physician in caring for the sick who sought the priest's prayers to the Gods for healing. Mothers and daughters probably nursed the sick in their homes.

During this time medical laws became fixed codes. They stated what a doctor could or could not do. Their religion forbade dissection. Under such conditions research could not be carried on and medicine as a science declined.

ANCIENT HEBREWS

The best resource book on the history of the Hebrews is the Old Testament of the Bible. The oldest contribution of the Hebrew people to the cultural heritage of the world was their religion – of one true God. Moses was one of the divinely motivated servants of God.

Many rules and regulations in regard to social and religious custom and health and sanitary practices are compiled into what is called the *Mosaic Code*. This code presents a systematic organised method of prevention of diseases. It includes principles of personal hygiene relating to rest, sleep, cleanliness, hours of work and special rules for women, midwifery, principles of public hygiene and sanitation regarding food, disposal of excreta, garbage, isolation, quarantine, disinfection and reporting of communicable diseases.

The high priest was priest-physician and health inspector. Houses of hospitality forerunners of later inns, hotels and hospitals were plentiful. They practised excellent hospitality. Visiting and caring for the sick was a religious duty. A nurse's role included midwifery.

ANCIENT AMERICANS

Highly developed cultures had flourished in the Western Hemisphere (North and South America) before Columbus and the Spanish conquerors discovered these lands. Though there were many groups which had existed, much is known only about the Mayas, Incas and Aztecs. Columbus sailed in search of our India, but when he landed in

the American side, he thought it was India and called the natives l found there, *Indians*. Later when the mistake was realised, those nativ were called *West Indians* or *Red Indians* and we in India ar differentiated as *East Indians or Indians*.

Archaeological findings have revealed that the Mayan Indians we skilled in astronomy, art and mathematics. Their religious practic centred around human sacrifices. The priests were the soothsayer medical advisors and pharmacists. They practised sweat-baths.

The Aztecs were a war-like group ruling central Mexico. They als practised sweat-baths to cure sickness and human sacrifices. At certai ceremonies they never hesitated to excise the living heart from th bodies of a thousand or more victims!

The Inca Empire was located in Peru. They were skilled enginee and built roads and suspension bridges. Their medical technique wa trephining and applying cranial bandage skilfully. Diseases were cause by anger of God. Gifts to God were in the forms of 'effigy' of the sic person. Their artistic records of patient care are still found. All th treatments used in the other ancient culture were used in this part o the world also.

Sand paintings were most useful in the ceremony for the healin of an illness. In addition to this a technique of hypnotherapy wa integrated into the healing ceremony. The patient was the centre o attention. The sand painting appealed to the sense of sight, th prayerful singing to the sense of hearing, the sweet-smelling herb t the sense of smell and the herbs to be eaten to the sense of taste. Fait on the part of the patient, shamam[1] and friends were very importan in this ceremony.

ANCIENT CHINESE

In China, long before the Christian Era, medicine and surgery wer honoured callings. Before 2000 B. C., they were allowed to practic dissection and so had good descriptions of internal organs.

They knew about the circulation of the blood. The doctors used systematic method of diagnosis much as our modern doctors use.

Their slogan was *look, listen, ask, feel*. Sen-Lung was known as the *Father of Medicine* in China. He was an authority in internal medicine and used many vegetable and animal drugs. They did vaccination as early as 1000 B. C. Physiotherapy[1] was practised. They recognised diseases such as, syphilis and gonorrhoea and used liver diet for anaemia, seaweed (iodine) for thyroid conditions and chaulmoogra oil for leprosy as early as 1200 A. D. In 1 A. D., they had 'halls of healing', next to the temple, where the sick prayed for healing.

Hygiene was important. Bathing and wearing clean clothes were advised and practised; drinking tea was an ancient precaution against intestinal infections.

The position of women, as defined by custom and according to Confucius (their religious leader for three centuries), was inferior to men. Marriage was her chief duty. She had to obey her husband and train her daughters in home management. Older women were loved and were greatly respected.

Medical progress was hindered by the beliefs of the common people. They believed that disease was due to evil spirits in the patient and that it might enter into anyone who touched the sick person. Thus nursing was impossible.

Japan copied China's system of Medicine. They used punctures originally by sharp stones (flints) and later by needles made of metal. This was developed into the art of acupuncture. It consisted of inserting needles, for an inch or so with a twisting motion into a particular area. Today this highly specialised branch of Chinese medicine has been copied and practised all over the world. Researches are being conducted as to other valuable benefits from this branch of medicine.

INDIANS

The earliest records of Indian medicine are to be found in the sacred books or *Vedas*. The *Ajur-Veda* is thought to have been given by *Brahma*. It is divided into a number of parts, which deals with prevention and cure of diseases in medicine, surgery, children's diseases,

[1]Physiotherapy – treatment with heat, light, water, electricity, massage, exercise, etc.

etc. From these early writings other authors wrote books. About 1,40 B. C. *Sushruta*, known as the *Father of Surgery in India*, wrote one o surgery. Years later *Charaka* wrote one on internal medicine. Fro these writings we learn that surgery had advanced to a high level, an that doctors and attendants (nurses) were people of high mor character. Hospitals were large and well equipped.

King Asoka (272 B. C. – 236 B. C.) a convert to Buddhism, brough about a period of prosperity. The Buddhist laws of mercy an compassion showed itself in ministrations to all sufferers. Hostels wer built for housing the sick, blind and deformed. A large number c hospitals were built not only for men but also for animals. The monasti universities at Taxila and Nalanda (Bihar) were world famous.

Prevention of disease became a matter of first importance an hygienic practices were adopted. Cleanliness of the body was a religiou duty. Doctors and midwives were to be trustworthy and skilful. The were to wear clean clothes and keep their nails cut short. Lying-i rooms were kept clean and well ventilated. Religious ceremonies an prayer preceded operations. The nurses were usually men or elderl women.

By 1 A. D. superstition and magic had been somewhat replaced b more up-to date practice. But, medicine remained in the hands of th priest-physicians who refused to touch blood or pathological tissue.

About 1000 A. D. as the Brahmin influence gained strength and re-established itself, Buddhism declined. The rigid Hindu caste system flourished. On religious grounds, any kind of physical contact with the non-caste people and *mlecha* was considered *contamination* to the Brahmins who were also the priest-physicians. Touching blood or any body fluid or tissue was pollution. Dissection was forbidden. To be virtuous and pure, many rituals were introduced by the orthodox priests. Superstition and magic, thus replaced the up-to-date practice of medicine.

In 1200 A. D Mohammadans invaded . India. This accelerated the process of decline of medicine.

ANCIENT GREEKS

The early Greeks believed medicine was of divine origin and was represented by many gods. Apollo, the sun god, was the god of health and medicine. Asklepios, his son, was the god of healing. His daughter was Hygeia, the goddess of health. Temples were built for these gods. A beautiful temple to Asklepios was built at Epideurus about 1143 B. C. Here a priest-physician was in charge. People came here not only to worship the God but the sick came for treatment and cure. Incubation was practised. That is, people slept in the temple, and during their sleep it was thought that God would appear in a dream and prescribe the special remedy or treatment required for cure. Medical treatments included special diets, massages, baths and inunction[1] .

The unclean such as the dying and obstetrical[2] patients were not allowed to come in or to remain in the temple grounds. It was not until after 170 A. D. that special buildings were erected for these patients. These were regarded as the first European hospitals.

Hippocrates, the son of a priest-physician, brought about the transition of medicine from magic to a science. He was born about 46 B. C. He spent much time observing symptoms and thus was able to teach that evil spirits did not cause disease but that it was due to man's disobedience of the laws of nature. Prevention of disease depends upon obedience to these laws. Since this was the beginning of scientific medicine, Hippocrates became known as 'the Father of Medicine'. He taught that doctors should observe their patients and then come to a conclusion as to the cause. The treatment should be based on the diagnosis. He developed ways of doing physical examinations and of taking their history. He stressed fresh air, cleanliness, and good diet for health. His writings gave instructions about hot applications, poultices, cold sponging for fevers, fluids for kidney diseases, and mouthwashes. He suggested the use of music and work to occupy the attention of mental patients. He stressed loyalty to one's profession and responsibility for those depending on the physicians. This is expressed in the Hippocratic Oath used in medial schools today.

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[1]Inunction – giving medicine by rubbing on the skin for absorption through the skin.

[2]Obstetrical – maternity, referring to child birth.

The caduceus, insignia of the medical profession is one of the gifts from the Greeks. This symbol is associated with Asklepios of Greek mythology. The caduceus, as in the accompanying illustration, is composed of the staff of the traveller, entwined with serpents signifying rejuvenated knowledge and wisdom and at the apex of the staff are two wings of Mercury for speed.

Serpents – rejuvenated wisdom.

Staff – readiness to go anywhere.

Wings – speed with which a physician should act.

THE CADUCEUS

ANCIENT ROMANS

Rome copied much from Greece, including their system of medicine. The city of Rome was made up of people from all parts of the world. There existed in Rome a fairly good system of sanitation. Paved roads and bridges were built drainage systems and sewers were made, drinking water was brought in by aqueducts[1] and there were public baths for men and women. They had a type of public dispensary.

Many physicians were Greek slaves who did not believe in Roman superstitions but tried to improve health practices.

The early hospitals were for soldiers and slaves, because they were of use to the state. Old women and men of good character did the nursing.

In the ruins of Pompeii (destroyed 79 A. D.) many instruments similar to our modern surgical scalpels, forceps, speculums, etc. were found.

THE IRISH CELTS

Ireland was the site of civilisation as early as 1000 B. C. It was called 'Hibernia' by the Romans. Many of these people migrated from Europe and brought with them the richness of art, music and literature of the Romans and Greeks. They developed several medical laws and practised moist-heat in their treatment and believed in attending to the 'peace of mind' of their patients.

The practice of medicine was regulated by Brehon laws, according to which every physician in Ireland was to keep one door of his house open at all times, so that the sick and the injured might be brought in. The physician was required to refund the fees if he failed to heal a patient. The law of 'sick maintenance' required that all the curative treatment, nourishing food and a place of care was to be provided, to those who needed them.

The status of a woman was high and she was treated with reverence.

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[1] Aqueduct – channel or large pipe for passage of water.

Summary

The Sumerians, Babylonians, and Egyptians practised medicine governed by a code, which included magic principles. They did not follow a scientific pattern to find the cause of diseases and to cure them.

The Hebrews have given us knowledge of hygiene, sanitation and preventive medicine in the Mosaic code.

The Chinese laid a firm basis to build the science of pharmacology and therapeutics.

The Greeks gave the medical leadership in the theory and practice of clinical medicines and clinical instructions.

In the ancient culture the place of the medicine man or the priest-physician was well established. But the concept of the existence of nursing and nurses was not very clear. The members who were skilled at caring for the sick and at helping the medicine man were the 'nurses' of those times. It is sad to note, when the Greek 'spirit of enquiry' lead to the scientific approach to medicine, there was no thought to bring 'nursing' along the same scientific line.

QUESTIONS FOR STUDY

1. **Egyptians**

   (a) What was *Ebers Papyrus*?

   (b) Who was an outstanding priest-physician?

   (c) How did the Egyptians prepare for life after death?

   (d) What was the position of women in Egypt?

   (e) Why did medical knowledge not progress?

2. **Indians and Chinese**

   (a) What books give the earliest records of Indian medicine? Name the two authors who wrote medical books.

(b) How did King Asoka bring about a social uplift?

(c) What practices did doctors and midwives carry out to prevent diseases?

(d) Why did medicine decline in India?

(e) What was the status of Chinese medicine at this time?

3. **The Hebrews, Greeks and Romans**

(a) Why is Moses called a great Sanitarian ?

(b) What was the relationship between religion, medicine and nursing in ancient Greece ?

(c) Why is it said that scientific medicine had its beginning in Greece?

(d) What sanitary practices were used in early Rome?

(e) For what purpose were the early Roman hospitals built?

Effigy – image of a person
Purging – make physically clean, evacuation
Cupping – bleeding a person by a cupping-glass
Leeching- use of bloodsucking worm for bleeding a person.

CHAPTER 4

EFFECTS OF SPIRITUAL LEADERSHIP ON THE DEVELOPMENT OF NURSING

EARLY CHRISTIAN ERA (1. A.D.-500 A. D.)

The powerful Roman Empire in the last several centuries of B. C. forcefully occupied the lands from Britain in the West through wha are now Spain, France, Italy and Balkan States to Northern Asia anc Africa. The powerful but cruel Romans ill-treated the slaves.

We have seen that nursing in Pre-Christian times was influencec by various religious beliefs. Many of these religions were fatalistic[1] ir their outlook on illness. They accepted it as a punishment or as a necessary evil. Christ did not accept illness as something necessary o deserved, but went about healing all manner of diseases (Matthew 9 12; Mark 5; Luke 9: 11; John 5: 9). Jesus Christ brought a new aspect that of 'altruism', into the religious teachings. Altruism means a thoughtful interest in others. Other religions taught that good work sympathy and kindness would bring benefits now or in the hereafter But Christianity taught that one would give kindly service to humanity without any hope of a reward, because of one's sincere love of Goc and a desire to be like Him. This is the highest motive given to mankind It greatly influenced nursing and helped to raise it to professional standing.

This charity - love in action - took root, flourished and expanded into the well-established field we know today. Nursing was nurtured in the early Christian period and there were individuals and groups who will be remembered for their example of comforting the sick and the needy.

To be like Jesus, His followers took upon themselves the care of the sick and poor. The Christian Church preserved records. From this era upto today we have a continuous record of the history of Nursing.

[1]Fatalistic- having the belief that whatever happens is an act of fate or bad luck that cannot be prevented.

APOSTOLIC ORDERS OF WOMEN

The Church taught equality of all men and women. The women assisted the clergy in the work of the church. Later on three orders of women developed.

The Deaconesses were ordained and did preaching and teaching and cared for the sick in their homes. They were mature women. A second order of Widows also assisted the Deaconesses with home visiting. The virgins were younger women who assisted in caring for the church vestments [1] and in giving out alms to the poor. They all lived in their own homes and received no pay, except when necessary.

One of the outstanding early Deaconesses was Phoebe. She was an intelligent, well-educated woman who did much travelling. Phoebe probably carried Paul's letter to the Christians in Rome (Rom. 16.) She helped to nurse the sick in their homes because Paul wrote, 'I comment unto you Phoebe, she is a succourer of many, of whom I am one' (Rom. 16: 1). She is known as the forerunner of the modern public health nurse.

Deaconess orders gradually disappeared after the 4th Century. The widows and virgins entered the monasteries as nuns and continued to assist the poor and sick.

EARLY CHRISTIAN HOSPITALS

The early deacons and deaconesses practised hospitality with religious zeal. They opened their homes to the poor, the sick or anyone in need. These private homes became known as *diakonia*. As time went on persecution of the Christians took place. Many who were poor, sick or persecuted now turned to the Bishop of the Church for aid. As his home became too small to meet the demands of hospitality additional rooms and shelters were added. In this way the Christian Xenodochium grew up.

It was a home for strangers and included hospitals for the sick, the insane and for those with leprosy. It also took care of orphans, the aged and travellers. All types of relief work were carried on in the Xenodochia.

[1] Vestments-gowns worn by priests in special religious services

One outstanding Christian hospital was built at Caesarea in Palestin by St. Basil in 370 A. D. It was like a small town and consisted of a inn for travellers, a refuge for the aged, sick, crippled, orphans an poor. Separate buildings were provided for those with communicabl diseases. Homes for doctors and nurses were built. St. Basil was a goo administrator. His sister, Macrina, a brilliant learned woman, wa probably in charge of the hospital section.

Emperor Constantine (272-337 AD) accepted Christianity and made it the state religion in 324 A. D. He and his mother, Empress Helena, gave money to build many hospitals and Churches.

THE ROMAN MATRONS

In Rome, we find that the women of high rank had much freedom, both socially and legally. As Christians, they became interested in works of charity and nursing. These wealthy women organised a group and used their wealth to fund monasteries and hospitals.

The leader of this group was Marcella. She had a palace in the best part of Rome where she gathered a Community of women about her and turned it into what became perhaps the first monastery in Rome. She became a friend of St. Jerome. She was very intelligent and spent much time in study with St. Jerome. She was often consulted as an authority in explaining difficult scriptural passages. She devoted her life to teaching, prayer and charitable work. She died in 410 A. D. from injuries caused by the invaders.

Fabiola was a beautiful young woman from a patrician family who had had two unsuccessful marriages. Under the influence of Marcella and the teachings of Christianity she became a Christian. She made a public confession of her sins and therefore gave her wealth and energies to the care of the sick and poor. In 390 A. D. she turned her home into the first free Christian hospital in Rome. She gathered the sick from the streets and devoted her life to giving them nursing care. When she died she was mourned by the entire Romans.

Paula was friend of Fabiola. She was wealthy and very intelligent. When her husband died she entered Marcella's monastery and became a Christian. She studied Hebrew and assisted St. Jerome in his

translation of the prophets. About 385 A. D., she and her daughter, Eustochia, went to Palestine and settled in Bethlehem. Here she built hospices[1] for travellers and hospitals for the sick. She and her staff did the nursing. She established a monastery in Bethlehem and gathered together a group of devout women. After her death, in 404 A. D., her daughter carried out her work.

During the lifetime of these famous women many changes were taking place. A new religion had been introduced and the Roman Empire was beginning to weaken. Marcella had introduced a new type of organisation, the monastery, under which men and women found self-expression and work outside their homes. These monasteries were to become a haven for many who lost their homes when the empire was destroyed by the barbarians.

During the first few centuries after Christ, asceticism arose within the Christian Church. This was a belief that care of the body was unimportant but neglect of it was a virtue. Time spent in prayer and meditation was important if people were to be ready for Christ's Second Coming. This often resulted in mal-nutrition and over work, which was a hindrance to nursing and medicine.

MEDICINE

Celsus, a Greek who learned much about anatomy, lived in the first century. He learned to do such surgical operations as those for cataracts and hernias.

In the second century, Galen who was educated in Alexandria, Egypt practised dissection on animals. He learned much about the anatomy and physiology of the heart and circulation, the respiratory and nervous system. He translated the writings of Hippocrates. For many centuries, these, together with his own writings were considered by the Arabs to be the chief medical authority.

At this period Medicine also was filled with human warmth and compassion. One of the best known doctors of this period was St. Luke the Evangelist –native of Greek. St. Paul called him beloved physician.

St. Cosmas and St. Damian, twin brothers, Arabs by birth and

Christian by upbringing, specialised in medicine and pharmacy. Th both practised in Asia Minor.

Soranus, a Greek, student from the great school of Alexandr became a famous obstetrician, paediatrician and the author of mar practical medical books. He did studies of muscles, glands and nerve

Summary

With the coming of Christ and the advent of Christianity responsibili to the needs of each individual was realised. Those who were the leade of nursing were from high society -- rich and intellectuals. Many we filled with the love of God and practised service to others. Teaching wa an important duty of those who cared for the sick.

Nurses were the early social reformers. The care was given accordir to the need -- in the community, in the hospital and in the home. The cared for persons of all ages, all types of illnesses and physical handicap

QUESTIONS FOR STUDY

1. How has Christianity influenced nursing?
2. (a) Name the three 'orders of women' in the early church.

   (b) Who is known as the first visiting nurse?
3. What kinds of social work were done at the Xenodochia of St. Basil at Caesarea?
4. Name three ancient hospitals still in existence.
5. Discuss the Roman Matrons under the following headings :
   (a) Their social life as compared to the majority of early Christian women.

   (b) Their noted teacher and friend.

   (c) Their individual accomplishments, i.e. the important work each was able to do.
6. How did the practice of asceticism influence medicine and nursing?

CHAPTER 5

SOCIAL AND SPIRITUAL FORCES IN THE EXPANSION OF NURSING

EARLY MIDDLE AGE (500-1000 A. D.)

The era began with the fall of the mighty Roman Empire and it is called *the dark ages* in history.

Barbaric tribes invaded Rome in 476 AD and brought about the final disorganisation of society. Unsettled conditions and struggle continued until 1000 A. D. During this time Roman armies were disbanded, roads and bridges were destroyed, robber bands crowded the highways making travel unsafe, homes were destroyed or taken over by the barbarians leaving many homeless.

Roman authorities moved the capital from Rome in the west, to Constantinople, in the east. Thus, when the barbarians settled in Rome many of the aristocracy left and went to Constantinople. Many of those who had to remain turned to the monasteries for help and protection.

According to the felt needs three protective units developed monasticism, feudalism and guilds.

MONASTICISM

For a time everything was in confusion. But many of the monks and nuns proved themselves to be exceptionally good organisers and administrators. The monasteries increased in size and facilities and new rules were set up to meet the needs of a changing society.

One outstanding monk was St. Benedict of Nursia. In 529 A. D., from the stones of a ruined temple he built a monastery on a rocky mountaintop between Rome and Naples. He encouraged all his

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Monasticism - life, rules, conditions of monasteries where or nuns lived.
Aristocracy – people of high rank, noblemen.
Pagan -people with no religious beliefs or who worshipped Idols.

neighbours, whether pagan or barbarian, to become Christians and work together in harmony. In time this small beginning on Monte Cassi grew to become one of the most efficient of the mediaeval monasterie

The Benedictine Rule was developed to meet their needs. Here a were required to work. In addition to customary monastic vows poverty, chastity and obedience a vow of life-long service was mad Extreme asceticism was not practised. Men and women were allowe to live purposeful lives devoted to the kind of work that they enjoye Because of this, arts, and crafts became highly developed. Methods i agriculture were improved, so more food was provided.

Men and women from all ranks and social classes were admitted t the Benedictine Order. It became one of the most active organisation for social work. Kings and queens, emperors and empresses entere and brought their wealth with them.

Throughout the Middle Ages the monasteries became the chie place for education, medicine and nursing. They gave medical an nursing care to travellers, the poor and the needy. Women in this er found in the monastery freedom to develop their own ideas and skills As the monasteries became wealthier they gained more freedom an political power. When they were criticised they made their rules stricte Many lost interest in the work when their freedom was restricted. As a result, between the 9th and 10th centuries the monasteries went into decline.

FEUDALISM AND CHIVALRY

Following the fall of Rome, much of the agricultural land was controlled by a class of gentlemen farmers. The homeless turned to these landlords for protection. Thus, an ancient system known as feudalism, but modified by Christian ideals, came into existence along with monasticism.

In feudalism the king owned all the land. He gave portions of the land to his favourite subjects who were the barons, earls or knights. These grants of land were known as a 'fief' or 'feud' in Europe and a 'manor' in England. Abbots and abbesses, as heads of monasteries, also held land as fiefs. The baron divided his land up among many

serfs, who worked on the land in return for food, shelter and a form of protection. Since there was no standing army the landlord might call on the serfs to leave the land and serve in his army when necessary. Monks fought for the protection of the monastery. The serf had very little freedom. If the land was sold he became the serf of the new owner. Petty quarrels among the knights took place and kept the serfs from the land. This resulted in famine and disease.

The Church felt that a systematic development of youth in ideals of solidarity conduct and ambitions was necessary. A system of training with elaborate ceremonies indicated the youth's progress and brought the knight under the influence of the church. The training of the knight, which became known as 'chivalry, stressed service to others, protection and defence of the weak. Every true knight came to believe that service to God came before service to his earthy lord. Chivalry was the accepted code for living a good life.

GUILDS

This was the first Organisation of workmen and tradesmen who were not attached to monastic or feudal groups. Divided into three categories these guilds protected the worker, the product and the public. The apprenticeship method of learning a skill was stressed, higher standards of work encouraged, unethical practices were checked and social insurance including sickness insurance was given.

The guild apprenticeship methods have been followed in nursing and medical teaching for many years. Also the guild was the forerunner of the modern labour unions and professional organisations.

SPECIAL CARE OF MENTALLY ILL

The first organised plan for the care of mentally ill and retarded children was found in Greece, Belgium. St. Dymphna had been made the patron saint of mentally ill people. Mentally ill people through centuries have been going to that town on a pilgrimage-seeking cure from St. Dymphna. Today the whole town is offering modern psychiatric home care to those seeking help. The nursing care is given by the Augustinian sisters, which is the oldest order of nursing sisters.

MEDIEVAL HOSPITALS

There were three famous medieval hospitals built outside monaster walls, which are still in existence.

1. Hotel-Dieu of Lyons in France or otherwise known as House o God's Charity founded by King Childebert at Lyons in AD 542. It wa built to give shelter for pilgrims, the poor, the sick and the infirm For 600 years it was under lay management and ' penitents' carrie out the nursing. From the twelfth to fifteenth century it was ruled b a religious order ; in the sixteenth century the management was take over by a body of men called 'rectors'. Nursing was done by dedicate women who took vows but could leave and get married later if the wanted. There were also nursing brothers. The hospital had large beds each capable of accommodating five patients. In 1640 the rector decided that all patients should have separate beds. In the middle o the nineteenth century the hospital had 1,100 beds, the brothers and sisters were strong, healthy, honest young people of the peasant class who were allowed to enter between the ages of 16 and 24. There was a very small staff for such a large hospital one nurse being allotted to 15 to 20 patients by day, but each night nurse was responsible for 100 patients.

2. The Hotel Dieu of Paris founded in AD 651.

3. The Santo Spurito Hospital of the Holy Ghost in Rome founded in AD 717.

ISLAM AND ARABIC MEDICINE

A new religion arose among the nomadic people of the Arabian Peninsula. Mohammed, the founder of Islam, was born in Mecca in 570 A. D. He said Allah, called him to preach a new religion. Each convert was called a 'Moslem' or 'one who submits'. This religion spread fast and the followers conquered lands. While so doing they learnt many things from other cultures and about medicine from the Greeks.

Islam did not allow surgery and dissection and so medicine did not progress. The famous physicians were Rhazes, Avicenna and Maimonides. They built medical centres in Cairo, Alexandria, Damascus and Baghdad. Hospitals were part of these centres and were of beautiful architecture

and well equipped. The Arabic scientists became highly skilled in preparing medicines. They introduced ligature known as 'catgut'. The care of the patients in the Moslem hospitals were of high standard.

Moslem women were absent in the care of the sick and were kept under 'Purdha'.

Summary

As the early Middle Ages ended, in spite of poverty, confusion and political unrest, the Church had grown, Christianity had spread, hospitals and institutions had risen. Islam and Arabic medicines contributed a lot to the development of medicine and nursing.

Nursing at last had developed roots, purpose, direction and leadership.

LATE MIDDLE AGES (1000 – 1500 A. D.)
THE CRUSADES

In the beginning of the eleventh century many pilgrims undertook long journeys on foot to places considered sacred because of association with persons or relation to their religious beliefs. Pilgrimages to Jerusalem, which is associated with the life of Christ, had started before the time of Paula in the 4th Century.

This journey on foot was very dangerous. Highways were few in number and overrun by robber bands. Many pilgrims became sick and weak. The few scattered hospitals and monasteries were unable to give aid to the needy. Food was scarce, so many stole or plundered the fields. Frequent disputes arose among the people. This gave the knights a chance to carry on their petty warfare. The church tried to bring about peace in the land by introducing the 'Truce of God', which set aside certain days when there was to be peace. Those who did not obey the rules were threatened with punishment. To escape these troubles the knights, filled with a spirit of adventure, decided to offer protection to the pilgrims.

Towards the end of the 11th century many of the Seljuk Turks became Muslims. They went about conquering many lands and people

for Islam and among them was Palestine. They built many mosques Jerusalem, the holy city of the Christians and started ill-treating t Christians. The religious war between the Moslems and Christians w known as 'Crusades'. It lasted for nearly two hundred years (1096 1291).

During the 12th and 13th centuries a religious movement known the Crusades took place. The Crusades were pilgrimage to Jerusalem rescue Christ's tomb from the Moslems. Urged on by Pope Urban large number of men, women and children left home and under t leadership of the knights and their soldiers they started out on the long journeys by foot. Many died on the way. There was a great ne for hospitals to care for the sick and injured. Two great military nursi orders came into being to undertake this work, namely, the Order the Knights Hospitallers of St. John of Jerusalem, the most importa one, and the other the Order of the Knights of St. Lazarus.

The early pilgrims had used the hospitals of Paula and in 10 A.D., some wealthy merchants of Amalfi founded two hostels Jerusalem ; one for men dedicated to St. John the Almoner, the oth for women dedicated to St. Mary Magdalene. These hostels took upo themselves a combination of warfare charitable relief and hospit nursing under devoutly religious control.

MILITARY NURSING ORDERS

The order of St. John was at first secular and not religious whe under Peter Gerard, the Knights and ladies renounced the world an took vows of poverty, chastity and obedience: but under the warri Raymond de Puy, the order became military and exclusivel aristocratic. Knights and ladies who joined the order had to belong t families who had never engaged in trade or menial work.

As the war-like characteristics increased they divided into Sectior --- knights, monks and serving brothers. The knights' first duty wa to fight, but when not doing so, they served in the hospital ward thus gaining the name *Knight hospitallers*. Priests or monks directe the religious life in camp and hospital and the serving brothers carrie on regular ward duties at all times.

Because of their excellent nursing and relief work the fame of the Order spread. Gifts of land and treasures made the order wealthy. They received and nursed the mentally ill with intelligence and sympathy. It was the only military order that did so. As a military nursing order they gave food to pilgrims, alms to the poor and cared for the sick. The hospitals at Jerusalem were of great architectural beauty and were well equipped. The knights and sisters wore a black habit with a white cross. The eight points of the cross represented the virtues of the order.

From the end of the 13th century its efficiency as a nursing order declined ; nursing was neglected, while political activities spoiled its reputation and it was finally suppressed. The fame and best traditions of the order live today in the St. John Ambulance Corps, First Aid to the Injured, Societies and Nursing Associations.

The Knights of St. Lazarus specialised in the care of leprosy patients. A sisterhood of St. Lazarus worked among the women. Its record is not as outstanding as that of the Order of St. John, but in nursing leprosy, it undertook a more sacrificial task and had many struggles with the social conditions surrounding these patients. As leprosy died out in Europe the Order declined.

Traces of the military form of organisation and discipline practised by these military orders have been passed on to modern institutions and are still seen in our hospitals today.

During this period the society built towns and developed a new social structure. Very soon the living conditions became bad, resulting in overcrowding and outbreak of many dreadful diseases due to improper sewage, inadequate supply of good water, public bathhouses and good sanitation. Dreadful diseases like leprosy, bubonic plague, smallpox and syphilis were on the increase. To prevent or cure disease, it was essential to withdraw the body fluids especially blood in the form of purging, [1]cupping, bloodletting and [2]leeching. The chief diagnostic aid was uroscopy, which consisted of the examination of urine.

The ideals of courtesy and honour of the knights and ladies made an impression on hospitals. Strict discipline and unquestioning

obedience was demanded. Their system of promotion is used in o training schools. Their love of ceremony, (hospital rounds, standi at attention for senior officers) have all been carried over into hospita The sacrificial life of the religious sisters who denied themselv everything for the sake of the sick, forms the basic ideal for nursi today.

MENDICANT AND SECULAR NURSING ORDERS (1000 – 1500 A. D.)

The period following the Crusades was one in which the peop showed intellectual growth with marked freedom and progress towar a more democratic[1] way of life. Cities increased in number and tra and commerce caused the development of a large middle class wh became very powerful. They brought in new ideas and cast away ol beliefs. When the old monastic systems were criticised they tried t improve the situation by making their rules stricter. This failed t attract people to enter the monastery. New methods had to be used fo a changing civilisation. It was felt that religion must be taken int the homes. This brought into being the Mendicant Orders. Th Mendicants were travelling monks. They divided their property amon the poor and earned their living by manual labour or begging.

DOMINICAN AND FRANCISCAN ORDERS

St. Dominic (1170 – 1221), who came from a wealthy Spanish famil was the leader of the Dominicans. They travelled about preaching an endeavouring to make Christianity known by teaching and example

The Franciscans were followers of St. Francis of Assisi (1182 – 1226 who belonged to a middle class family in Italy. He was of a happy carefree nature, which helped to make friends easily. After some troubl with his father he left home and lived in the woods, where he vowe to give service to God.

He became interested in patients with leprosy and gave them devoted service while doing odd jobs to earn his few bare necessities Others were attracted and joined him. In humility they wore the rough woollen robe of the peasant tied around the waist by a rope, and took vows of poverty and service to the poor.

St. Francis did not stay in isolation with his leprosy patients but helped their community to see their responsibility in caring for these patients. A beginning was made to improve the social conditions and start preventive sanitary measures.

A second Order of St. Francis was known as the 'Poor Clares'. It was an order of women under the leadership of Clarissa, a rich young woman who had secretly, at night left her home and gave up all to follow St. Francis. The women did not beg but the brothers provided food for them. In return the women mended the brothers' clothes, cared for the church property and gave nursing care to the sick, especially those with leprosy.

Secular Orders

St. Francis and his work attracted so many men and women that he found it necessary to start a third order, the Tertiaries. These people stayed in their own homes but carried their religion into their everyday life by their acts of charity and ministering to the sick in their homes and in the hospitals. This was known as a secular (non-religious) order because the men and women could live at home, they took no vows and were free to leave the order at any time.

Other secular orders arose but many did not last for long. Perhaps one of the most outstanding was the Beguines (be geens) of Flanders. The members took simple vows of chastity and obedience. They supported themselves or received help from the Society's funds. Small cottages built around the church were known as 'beguinages'. Three or four members, if not married, lived in each cottage while married members lived in their own homes. The members did private, hospital and visiting nursing. The Communities spread throughout Belgium, France, Germany, and Switzerland. They have existed to the present although not as active in nursing as formerly. They gave aid in time of war or disaster.

INDIVIDUAL NURSE

In Medieval times nursing was considered religious duty. Many men and women gave outstanding service, but only a few can be mentioned.

St. Hildegarde (1098 – 1179) was of noble birth. From the age o eight years she was educated in a double monastery. When she grew t womanhood she established her own convent and ruled as the Abbess She devoted much of her time to the study of medicine, nursing and natural science. She became famous for her advice and healing. Sh believed in the use of water and plenty of fresh air. She wrote book on medicine in which she described such conditions as jaundice, lung diseases, and dysentery.

St. Elizabeth of Hungary (1207 – 1231) was of the royal house o Hungary. She fed the poor at the castle gates, visited the sick in the hospitals where she gave baths, did dressings, and cared for children.

St. Catherine of Sienna (1347 – 1380) was from a middle class home where very early she was taught to do housework. She was an ascetic and practised severe penances[1], such as beating herself for the sins of others. In her spare time she visited the sick in the hospital of La Scala. She learned to read when she was 24 years old and four years later learned to write. This was an accomplishment possessed only by the nobility in her day. She became a member of the Tertiaries. When the plague came to her town in 1372, she spent long hours, day and night, giving care to the patients in the hospital. Her lantern, which she carried on the long night trips between her home and the hospital, held the same significance for the sick people of Sienna, that Miss Nightingale's lamp, in later years, held for the wounded at Scutari.

Abbess Euphemia director of a Benedictine monastery in England was famous as a pioneer of modern hospital design.

Queen Elizabeth of Portugal known as St. Isabel, a grand niece of Elizabeth of Hungary founded a hospital for the poor and nursed the sick.

Queen Isabel gets the credit for having introduced the tent-type hospitals and ambulances for the injured on the battlefield.

Queen Matilda-affectionately called 'Good queen Maud' wife of King Henry I of England founded hospitals and personally gave care.

ORGANIZATION OF HOSPITALS

Crowded living conditions and increase in the spread of diseases caused a demand for more hospitals. The existing ones were used as

almshouses, orphanages and inns for travellers as well as for the sick.

Pope Innocent III (1200) inspired by the Moslem hospital set-ups constructed a hospital, beautiful in architecture and efficient in management and nursing care. During the next hundred years literally thousands of such hospitals were built encouraged by this Pope.

The first hospital in England (936 A. D.) was built at York followed by St. Bartholomew's Hospital (1123) and St. Thomas Hospital (1213) in London. St. Thomas hospital in London was used for many years later by Florence Nightingale for the clinical experience of her nursing students. These two were the only hospitals, which continued when all other hospitals and religious monasteries were closed during the Reformation. Bethlehem Hospital known as 'Bedlam' later became the first mental hospital in London. Many other hospitals were built in different parts of Europe.

LEARNING INSTITUTION

Institutions of learning and intellectual awakening developed up to the University level in arts and literature. This was the period of 'Renaissance'. Latin was the language for teaching. The two main audio visual aids used for teaching were beautiful tapestry and magnificent stained glass windows. Renaissance did not occur in the field of medicine because doctors had faith only in the theory of Galen and the influences of stars and planets in the lives of men.

Summary

During the Middle Ages, medicine in Europe was under two influences. The lay medicine followed after the Roman tradition and the religious medicine as existed in the monasteries.

Crusades stimulated the growth of the military nursing orders as well as encouraged the spread of diseases and brought Europe in contact with Arabic medicine. The sudden spread of cities increased cultural growth, but with that many more problems were added. Travel and trade flourished increasing the exchange of ideas, attitudes and materials between the western and the eastern world.

This period finds nurses from high society and of high intellectual

abilities responding to the needs of society in times of war, epidem and persecution. The three organisations of orders, the military, t regular and the secular which worked under the guidance of the Chur have remained in some form to the present day and have establish certain principles which are still recognised as important in Nursin

Variety of hospitals in great numbers was built. One finds ci hospitals built within the walls of the city and isolation hospita placed outside the city, which took care of those suffering from plagu smallpox and leprosy. Renaissance took place in arts, architecture a literature but there was no improvement in medicine and nursing.

QUESTIONS FOR STUDY

1. Following the downfall of Rome, to what co-operative units di the people turn for help ?
2. Describe the life of a monk or nun in a Benedictine monastery
3. If you were a serf on a 'fief' in Europe –
   (a) What would your duties be ?
   (b) To whom could you go for care during illness ?
4. What was chivalry and how did it develop ?
5. What provision was made for the care of the sick and wounded during the crusades ?
6. How has Monasticism, influenced nursing today ?
7. Name three mendicant orders ; by whom were they organised and what special work did they do ?
8. How did secular nursing orders differ from monastic nursing orders ?
9. Name three nursing saints. With what special work is each one associated ?

CHAPTER 6

RESPONSE OF NURSING TO THE NEEDS OF SOCIETY 1500–1850 A.D.

HISTORICAL BACKGROUND

From the year 1500 for the next three centuries we see many changes had taken place. Political and industrial revolution ; the [1]Renaissance and the Reformation affected nursing for the period from 1500 to 1860 A. D.

The Renaissance

Ambitions of businessmen and nations expanded their trade to new lands including America. The ships built with compass, improved transportation and many new expeditions were made. As a result of travel and mixing of people with other lands men became more independent and new ideas brought about advances in many areas. New ideas in art, architecture, and literature were developed. The invention of printing helped to spread ideas. It also resulted in the rapid increase of medical books. The famous men who contributed to the renaissance in Medicine were Leonard da Vinci with his anatomical studies and drawings ; Andreas Vesalius (1514 – 1564) founder of Anatomy as a Science ; Ambroisa Pari (1510 – 1590) with his outstanding work in surgery ; William Harvey (1578 to 1657) with the discovery of the circulation of the blood; Thomas Sydenham with his contribution of setting up clinical method of teaching and many others.

The classical revival and literary work by great men stimulated men and women to classical scholarship. They became more and more worldly under pagan influence. The emphasis placed by medieval forbearers on the virtues of self-sacrifice and self-denial was cast aside. The new state of mind reflected itself in the general attitude toward charitable works, and in particular on medicine and nursing.

charitable works, and in particular on medicine and nursing.

Industrial Revolution

Spinning and weaving were done in farmhouses prior to th invention of power and machinery. With the power loom and spinnin done in factories, the farm house people who wanted work had t move where the factory stood. Its members had to adjust to new way of working. Wages were low, working hours were long. Children wer to work for long hours. Farmers, who owned small farms, becam labourers in factories owned by the rich. The number of manufacturin cities grew and with it the problem of living in unsanitary conditions

The Reformation

The Reformation or Protestant Revolt of the 16th century was a movement to free the Church from its malpractices. Two outstandin groups emerged at this time. One group under the leadership of Ignatiu Loyola decided to stay with the Church. They became an order o teaching clergy. The missionaries of this Society of Jesus, commonl known as 'Jesuits' were among the earliest of trained teachers. They became leading educators especially in institutions of higher learning. The women's order called "the order of St. Ursula" was dedicated to the education of girls. The other group under the leadership of the revolutionist Martin Luther became 'Protestants'. His emphasis on faith rather than works as a means of salvation was misinterpreted by his followers which reduced the interest of men and women in self-sacrificing careers. This and the other general trend of the time caused a marked loss of interest in things charitable and humane.

Political Revolutions

The ambition of Kings led to war and the spirit of national competition. The poverty which followed the wars brought a discontentment that flared up in a series of equally great revolutions--- the American Revolution (1775 – 1783) the French Revolution (1789 – 1795) and the Latin American Revolution (1800 – 1825). These revolutions changed the attitude of people towards human inequality. They began to think in terms of equality and rights of

individuals. From the angry masses arose the dictator Napoleon. The Napoleanic wars began in 1797 and ended in 1815 when Nelson the Duke of Wellington at the battle of Waterloo, buried dictatorship for a time. At the beginning of the nineteenth century in England, democracy was in the lead.

Hospitals and Nursing

It is commonly agreed that the darkest period in the history of nursing was that from the 17th to the middle of 19th century. While the Secular nursing societies of the 12th and 13th centuries were gaining strength many of the older, more conventional orders approached a stage of stagnation. The French hospitals, especially Hotel Dieu of Paris, were managed by the sisters who had a lot of freedom. In 1212 the bishops in the council drew up regulations for the French Hospitals including rules for the nursing staff. It was decreed that all nursing orders were to take vows of poverty, chastity and obedience. They further decreed that to economise the gifts of the faithful, the nursing work in hospitals should be performed by the smallest possible number of sisters. They became a cloistered order as they could not go beyond the hospital walls except with permission of the clergy. During the later-middle ages the church continued to limit women's freedom. In 1545 the "Council of Trent" decreed that every community of women should live in 'strict enclosure'. It took 200 years of resistance for women to overcome this decree, which caused great hardships on those who felt capable of active, useful careers, yet who desired to remain faithful to church. The Beguines refused to be enclosed and continued their visiting nursing. The nursing sisters of France, however, offered little or no resistance and their professional standards retrograded in consequence. After the Protestant revolt, monasticism continued to decline as the Protestants had withdrawn their support and there was a general lack of interest in monasticism.

In England King Henry VIII came into conflict with the church as he failed to get his divorce sanctioned by the church. He was said to have destroyed six hundred monasteries including more than one hundred hospitals. The wealth thus taken from the monastic orders was turned into institutions for men and thus the previous

The breaking up of the religious organisations created a seriou problem about the care of the sick and poor. State and Cit Governments had to find a solution. Many municipal hospitals wer built. These hospitals were managed by politicians[1] who were no medical persons. Expenses were kept at a minimum. Since nun and monks were not available for the care of patients lay people wh lacked religious motive and were often illiterate were hired to care fo them. These women because of long hours of cheerless work becam hard and cruel. They were paid very little. A strong drink wa often their refuge from the drudgery of life. Younger women wer given day duty and older women night duty. No previous training wa looked for nor character and conduct given any consideration The doctors did most of what we consider to be nursing duties, such as changing sheets, doing dressing and giving medicines Occasional bathing and care of excreta etc. were done by servants Nursing included mostly cleaning, laundry and scrubbing.

The unsanitary conditions in the hospitals made them a source of outbreak of many epidemics. The wards with almost windowless walls held as many as a hundred patients each. There was no segregation or isolation of patients. The beds were large and several patients were put together. The very sick patients were kept in the same bed occupied by several others. In a room leading off the ward, a nurse who had been on duty all day slept at night, so that she might be within hearing of her patients. The patients were mostly poor and friendless. Little visiting was done. So the public did not know about the existing conditions. It is not surprising that the average family of those days dreaded and avoided the hired nurse and the hospital.

During this dark period in nursing, nurses were poorly fed, over-worked, and badly treated. Only those who could find nothing else to do, did nursing. Nurses lacked in skills and morals. Under such conditions women of refinement and intelligence would not take up nursing. Religious orders reopened and tried to bring back some of their traditions. Other people, known as humanitarians, did much to

[1] Politician--one who is concerned with matters of civil government

relieve the depressing situations of the times.

HUMANITARIANS [2]

St. Vincent de Paul (1576 - 1660) became the outstanding philanthropist [3] of his time. His work set the pattern for modern social work. His methods are still used today. To prevent begging he built municipal lodging houses, started trade schools, and formed colonies where these people could learn to support themselves.

Mlle.le Gras, later known as St. Louise de Marillac, assisted him in organising the Sisters of Charity in 1633. This was a lay organisation of women who were trained in charity work of which nursing became an important activity. They were much in demand for work in hospitals and in the homes of the wealthy. St. Vincent's influence was lasting and was an important stimulus to a better quality of nursing.

John Howard (1727 - 1789) had an experience, as a prisoner of war, in a prison in France. After his release he set out to see if other prisons were as bad as the one he had been in. He visited many filthy gaols (jails) and dark dungeons. He wrote up his reports and had them published, and sent them to the rulers responsible for these conditions. He was rewarded by seeing many changes brought about in these institutions. He also visited hospitals and made reports in which his comments were unprejudiced. He gave credit where credit was due. He told of the good work done by the Beguines and the Sisters of Charity.

Elizabeth Fry (1780 - 1845) was responsible for bringing about changes so that better care could be given to women and children in Newgate prison in London. She became interested in nursing. In 1840, with the help of her sister and daughter, she succeeded in organising the 'Protestant Sisters of Charity', a group of women who did hospital visiting. The name was later changed to 'Protestant Nursing Sisters'. They lived outside and went to Guy's Hospital for a few hours a day to work under the doctors and untrained ward nurses. They became nursing attendants in private homes. The order still exists.

[2] Humanitarian--a person who does charitable deeds

[3] Philanthropist--one who uses his wealth,time and efforts for the benefit of others

Amelia Sieveking started a home visiting association in Hambur Germany. Her 'Friends of the Poor', as they were called, nursed chole patients during an epidemic.

Charles Dickens (1812 –1870) wrote humorous stories in which described the evils of his day. *Martin Chuzzlewit* is a book abo selfishness and evil practices. In this book Dickens describes two nurse Betsy Prig, a hospital nurse and Sairey Gamp, a private duty nurse. showed up the poor manners, the lack of education and the bad habi of nurses at that time, and helped to make the public aware of th need for reform.

Dorothy Lynde Dix (1802 – 1887)

She was called the 'John Howard of America' for her work for th care of mentally ill and the criminal. The present system of ment hospitals in America under government control has gradually com into being as a result of twenty years of effort on the part of Miss Di Their foundation principles of expertness of supervision, leg commitment based on medical diagnosis and abolition of restrain were advocated by one who knew from observation and experienc the value of such basis. She carried on this work in England an Europe also.

CATHOLIC AND PROTESTANT ORDERS

During this time a number of religious orders, both Catholic an Protestant arose. Each worked to improve nursing. Some died ou soon but others have carried on to the present day. Two of thes orders might be mentioned. 'The Sisters of Charity' was a Catholi order started by Catherine M' Auley in Ireland. In 1832 they starte nursing in the Dublin hospitals. From this time nurses from this orde have gone to all parts of the world. In 1848 'St. John's House' wa established by the Church of England to give systematic training t nurses in hospitals and to attract young women of the middle clas into nursing. Nurses from both of these orders went to Crimea wit Miss Nightingale.

THE REVIVAL OF THE DEACONESSES

In 1822 Theodor Fliedner came to be pastor of a small parish in Kaiserswerth, Germany. That year the silk crop had failed, so the people were poor. Pastor Fliedner went through Europe and England to collect money to carry on his Church work. He was very much interested in the work the humanitarians were doing in prisons and hospitals. After seeing the work of the deaconesses in Holland he felt this order should be revived in Germany. But to do this he needed the help of a woman.

Pastor Fliedner met and married Frederika Munster, a women who had organised and administered a children's home. They rented a large house and set it up for a hospital and deaconess home.

In 1836 their first patient was admitted. Also, Gertrud Reichardt, the first nurse deaconess, came to begin her training. She was a doctor's daughter and had helped him to care for his patients. Six other deaconesses were admitted in the first year.

Mrs. Fliedner was a good superintendent. She wrote notes on nurses' training, the first ever written by a woman, and taught practical nursing. Pastor Fliedner taught religion and ethics. A doctor taught theoretical and bedside nursing. Students also studied pharmacology and wrote the state examination for pharmacists.

The deaconesses' chief work was nursing, but they also cared for orphans and ex-women prisoners and taught in schools. Each deaconess was in charge of a department and they were rotated so that each had experience in the hospital wards, the kitchen, laundry, garden, and chapel.

Fredericka died in 1842. The next year Pastor Fliedner married Caroline Berthean. She was a nurse in a Hamburg hospital and had had experience in administrative work. For nearly forty years she was able to carry on the work started by Fredericka.

Many visitors came to see and study Kaiserswerth's methods. Among the visitors were Mrs. Elizabeth Fry and Florence Nightingale. News of this successful work spread. Fliedner was asked to bring some of his deaconesses and to start work in many other countries. In 1864, when Pastor Fliedner died, there were thirty-two deaconess houses. This was

the beginning of the Mother house system. Here the deaconesses too no vows and received no salary but had a permanent home for life.

Modern School of Nursing has adopted some of the principle established at Kaiserswerth. They require a health certificate an character recommendations, use the preliminary or probationar system, give regular classes, give stipends, have a woman in charge o nurses and nursing, and insist that nurses must follow the doctor' orders. Nurses who went into private homes were treated as member of the family and not as servants. This helped to raise the position o nurses. Although the Deaconess Order was under the control of th church it prepared the way for modern secular nursing.

MODERN NURSING

Progress in medicine and Science during the past three centurie has increased the interest for better nursing service and nursin training. New scientific facts were discovered and many new precisio instruments such as the stethoscope, microscope and thermomete came into use. The discoveries of such men as Pasteur, Lister, Koch and Loffier brought about new developments in medicine, surger and sanitary science. In order to keep up with the many changes it was necessary to increase the educational facilities for students of medicine. Higher Standards were required for entrance. New techniques were developed in medicine. Likewise a new type of nurse who was trained in the art of carrying out these techniques was required. The social reformers focused attention on the poor and needy. Leadership in nursing was needed to train the modern nurse to be the doctor's efficient co-worker. The person who responded to this call was one of those rare and gifted persons named Florence Nightingale.

FLORENCE NIGHTINGALE

Early Life

Florence Nightingale was born on May 12, 1820. She was the second daughter of wealthy English parents. Her mother was the daughter of a Member of Parliament. Her father was a college graduate. He knew foreign languages and mathematics and enjoyed reading history, philosophy, and the classics. In spite of the hardships he enjoyed travel.

After his marriage to Mrs. Nightingale they went to Europe. Thus it happened that Florence and her sister were both born in Italy. The Nightingales had two large homes. 'Lea Hurst' was in the North of England and 'Embley Park' was in the South. Florence and her sister, Parthe, spent a happy carefree childhood.

A Governess[1] was always part of the household, as Florence's parents wanted their daughters to be well educated. Florence and her father were very good friends. He taught her Latin, Greek, mathematics, science, and politics. She also learned German, French, and Italian. She enjoyed reading her father's books and discussing them with him. But her mother could never understand her serious nature.

When Florence was seventeen she went to Europe to finish her education. She spent one and a half years travelling and enjoying the scenery, art, and society of Italy and Switzerland. Here she met some of the most outstanding men of France. She was interested in politics and people, but social conditions and charitable institutions especially drew her attention because she felt that God had called her to fulfil a 'Mission of Mercy'. – She thought of nursing or education work.

At home in England she visited a village beyond Lea Hurst and here she observed the life of the poor and tried to relieve the sick. In her diaries she expressed the need for using her talents in working for others. Nursing appealed to her as the field in which she could do this best. Because of the terrible conditions which existed in the hospitals, her parents refused to allow her to take this training. Her mother felt that she should marry. Although there were several young men interested in Florence, she would not consent to marry any of them because she still felt called to do a special work. What it was to be, she did not know.

In her home Florence met many people who were interested in social reforms. She studied the sanitary reforms of Sir Edwin Chadwick. Mrs. Fry told her about the deaconesses at Kaiserwerth. Florence dreamed of forming a Protestant sisterhood of educated women who could become skilful nurses.

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[1]Governess--a woman who cares for and teaches children at home

In 1847 Florence visited Europe again. In Rome she entered convent for a ten-day retreat. Here she listened to the addresses giv to the new nuns and observed their mode of life. She made notes all she observed for future use. During this visit she met Mr. and M Sidney Herbert. She was much interested in their plans to start hospital in England. A friendship arose between them which was have lasting results.

Two years later, on another trip, Florence visited Alexandria, Egy where she learned about the work of the Sisters of Charity of S Vincent De Paul. In Greece she met some American missionaries ar studied the organisation of their schools and orphanages. In Berli the capital of Germany, she visited hospitals. Finally, in 1850, sh visited Kaiserswerth for two weeks. Here she saw what had alread been done and discussed with the Fliedners their plans and hopes f the future. She became more impressed with the need for systemat training for nurses. The way opened up for her to return to Kaiserswert the following year for three months training. She did not conside the nursing done here to be of a very high standard but she gaine many ideas from the efficient methods of administration.

In 1852 she was determined to do nursing. Her parents rathe unwillingly gave their consent for her to go abroad to study the wor of the Sisters of Charity in Paris. She had permission to visit hospital infirmaries, and religious houses. She was able to watch some of th outstanding surgeons at their work. Thus her ideas, regarding a organised training programme for nurses, became more firmly fixed

When Miss Nightingale was thirty-three years of age she insiste that she be allowed to live her own life. When her parents saw tha they could not change her ideas they consented. Her first positio was as Superintendent of an 'Establishment for Gentle women durin illness'. In this position she brought about changes which showed he exceptional ability as an organiser and administrator.

Crimean War 1854 – 1856

Miss Nightingale was planning to become Superintendent of King' College Hospital when word reached England about conditions in Crimea. England and France were helping Turkey in a war against

Russia. Russia and France had religious sisters to care for their wounded soldiers.- England had only untrained men. An appeal was sent out for help and supplies. Miss Nightingale, who was looking for 'a field worthy of her powers', read these appeals. She wrote to her friend, Sir Sidney Herbert, who was Minister of War, and offered her services ; then began preparing nurses and supplies. At the same time Sir Sidney Herbert wrote to ask her to organize a band of nurses to be sent to Crimea. Their letters crossed, so each had their answer. Five days later she received official recognition and her instruction from the Government. Two days later she, with thirty-eight nurses selected from the Catholic and Protestant orders and from the hospitals, set out for Dardenelles in Crimea.

They landed at Scutari where there were two hospitals. Miss Nightingale was assigned to the Barracks Hospital with fifteen hundred patients to care for. Five or six nurses had to share one room, which they used for eating and sleeping. The hospital wards, likewise, were crowded, dirty, and poorly ventilated. Water was scarce. There were no sanitary arrangements. The beds were of straw and mostly on the floor. The few sheets were of rough canvas. No washing had been done. There were no basins, soap, towels, or hospital clothing. The men were still in their blood soaked uniforms. Filth and vermin [1] were common. The food was poorly cooked and of a kind that very ill could not eat. Since it took four hours to serve a meal, food was given at long intervals. Cholera and other contagious diseases were present. More soldiers died of disease than of wounds. Forty-two per cent of the treated patients died.

Many difficulties had to be overcome. Many army officers and surgeons were satisfied with their untrained help. They did not want women in the army because they considered them interfering and troublesome. A few officers welcomed them. Often supplies were sent to a wrong port or were buried under the war materials ; thus there was delay in getting them when needed. There was no co-operation between the different war departments.

Florence Nightingale proved to be an excellent commander. She accepted the responsibility of nursing the soldiers and did things no

[1] Vermin – harmful small animals and insects such as bedbugs, flies, lice, fleas,mice, rats, etc.

one else could or would do. In emergencies she used her own money. She ordered several hundred scrubbing brushes and cleaned the wards. Patients were bathed and put into clean linen. She opened five diet kitchens throughout the hospital and saw that diets were given according to the needs of each patient. Repairs were done to improve the building and to care for the disposal of sewage. Her nurses were under strict discipline and worked only with the doctors who requested them. In two months the hospital was reformed and in six months the death rate was reduced to two per cent. By this time she had won over most of the doctors. With her own money she set up an [1]autopsy room and provided the necessary instruments for the doctors. This was the beginning from which the British Army Medical School developed.

Miss Nightingale spent her evenings visiting the sick, writing letters to the soldiers' families, and writing long reports which she sent to Sir Sidney Herbert. She set up laundries and hired the wives of soldiers to work in them. She set up reading rooms and post office services whereby the soldiers could send money home to their families.

In the summer of 1855 Miss Nightingale, with three Roman Catholic Sisters, went across to Balaklava to visit the hospitals and plan for necessary changes and improvements. While there, she contracted Crimean fever. She was very ill but refused to take sufficient rest. Instead she returned to Scutari. Some time after her recovery, peace was declared in the spring of 1856. The hospitals were closed. Miss Nightingale returned to England with the last nurses.

The people of England wished to honour Miss Nightingale in some way, but she disliked publicity. On the suggestion of Sir Sidney Herbert a fund was raised to start a Training School for Nurses. Miss Nightingale accepted the money but was unable to start the school (1860) until later.

Post-War Activities and Honours

Following the war Miss Nightingale worked for a number of years to bring about better health conditions in the British Army. She wrote, Notes affecting Health, Efficiency and Hospital Administration of the British Army. Methods which she suggested to keep the soldiers healthy

1Autopsy-Examination of dead body to find the cause of death

have been used in many countries. She also began to work for better sanitation for the English army in India. She planned a complete public health programme much of which was put into practice through a Royal Commission. In this connection she wrote two pamphlets – *How people may live and not die in India* and *How some people have lived and not died in India*. Her knowledge of conditions in India is more remarkable since she was never able to visit this country.

Miss Nightingale knew the Queen and many of the Cabinet Ministers and thus had much political influence. She became Adviser-in-General on all hospital and nursing topics for the United Kingdom and other countries. Her writings, *"Notes on Hospitals"* written in 1858 and *"Notes on Nursing"* written the following year were considered as standard guides for over fifty years.

Although Miss Nightingale worked by herself in her room she remained active until nearly eighty years of age. In 1907 King Edward conferred on her the Order of Merit. This is the highest order bestowed by the British Crown and she was the first woman to receive it. In 1909 she was granted the "Freedom of the city of London". On August 13, 1910 she died peacefully in her sleep. She might have been buried among the great in Westminster Abbey, but her family knew she would rather be in the family plot at East Wellow, Hampshire.

The Nightingale School at St. Thoma's Hospital

St. Thoma's Hospital London, was chosen as the hospital for Miss Nightingale's School of Nursing. Miss Nightingale was not physically able to be the superintendent. Fortunately, Mrs. Wardroper, Matron of St. Thomas Hospital, agreed to act under Miss Nightingale's directions. Miss Nightingale approved of Mrs. Wardroper because she was an excellent teacher, a good judge of character, and strict in her discipline.

The Nightingale School was opened in June, 1860, with fifteen probationers selected by Miss Nightingale. They received one year of training as probationers. To attract educated young women there were two classes of nurses. Special or paying students paid a fee and worked on the staff for two years after their probationary training ; other students did not pay fees but worked for three years after their training.

At the completion of their time they became Certified Nurses. Their names were put on the School register and the Nightingale committee found them hospital positions on salary. The Nightingale Nurses were trained to be hospital administrators and teachers but not private duty nurses.

Some of the principles that Miss Nightingale established in her School were:

1. Nurses should have practical training in a hospital set up for that purpose.
2. A nurse must direct nursing education.
3. Nurses should live in a 'home' fit to form their moral character and discipline.
4. Education is necessary for a nurse because she must know 'the reason why' if she is to teach others. Theory and practice must be correlated. i.e. brought into very close relation to each other.
5. The School should be economically independent.

The course of study included class-room and bedside classes by the sisters ; theoretical classes and examinations by the doctors, and each nurse was to keep a notebook in which she kept a record of her daily observations, treatment and care given to her patients.

Miss Nightingale's idea in training nurses was that they should learn how to give good care to the sick. She believed that nursing is an art and a science and as such must continually progress ; also, that good nursing has a definite moral influence. Her experimental school was a success. Thus she proved that nursing could be a secular career for a better class of young women.

As a result of Miss Nightingale's work, the attitude towards nursing was changed. A new career opened for women and doctors were convinced of the superiority of the new method and approved it. Nightingale graduates were sent out to establish schools of nursing and became matrons in hospitals in England, her colonies and America. Young women from Europe came to study at the Nightingale School and returned home to set up schools on the same pattern. Thus,

between the years 1860 and 1893 the Nightingale system of training nurses spread to all parts of the world. Graduates from these schools became the early pioneers in nursing education.

NURSING REFORMS IN AMERICA

In America, following the Civil War, the need for better nursing was felt just as England and Europe had felt the need after the Crimean War. In 1873 the Bellevue Hospital Training School in New York was one of the first schools to be established on the Nightingale plan.

Isabel Hampton was an outstanding graduate of this School. In 1886 she became Superintendent of the Illinois Training School. There she introduced a graded system of theory and practice. In 1889 she went to Baltimore and established the training school Johns Hopkins Hospital. This became a model for other American schools. In this school she established definite hours for duty, meals, and recreation. Because of the lack of textbooks written for nurses she wrote one which became a standard text in American Schools, namely ***Nursing***; *Its Principles and Practice for Hospital and Private use*, and later wrote *Nursing Ethics*.

When Miss Hampton married Dr. Robb, in 1894, one of her pupils, Mary Adelaide Nutting, from her first class at Johns Hopkins Hospital, was ready to carry on as Superintendent. Miss Nutting introduced a preliminary course for students before they began their actual ward practice. She also reduced the nurses' duty time to eight hours a day, and extended the training period to three years. She worked with Miss Lavinia L. Dock, another outstanding graduate of Bellevue, in writing four volumes of a standard text on the history of nursing.

In 1898 when Teacher's College, Columbia University, was selected to give a course to prepare nursing administrators, Mrs. Isabel (Hampton) Robb was chosen to conduct a two-year course. In 1907 a department on Nursing and Health was established and Miss M. Adelaide Nutting came to teach the course. Under her the school developed and became a world influence. Students from many countries, including India, have studied there.

MODERN DISTRICT NURSING

A new phase in nursing history was started in Liverpool in 1862. William Rathbone became interested in providing home nursing for the poor. He wrote to Miss Nightingale but at that time she had no nurses available and none were trained for district work. She suggested starting a school to train nurses for this work. Mr. Rathbone supplied the building and equipment and a Nightingale nurse became the first superintendent. A similar course was started in London. The students received one year in hospital training and six months in special instruction in home nursing in the district. Since only ladies of high status were admitted to the course the status of nursing was raised. The schools were the forerunners of the modern schools for public health nursing.

This became the first speciality in nursing. Mr. Rathbone took pity on the terrible condition that existed in the workhouse and infirmaries and worked to improve the nursing service for the twelve hundred patients in the Liverpool Infirmary.

QUESTIONS FOR STUDY

1. What was the effect of the Industrial Revolution (1750) upon Society ?
2. During the 'Dark Age of Nursing' what type of women were employed as nurses ? What preparation did they have ?
3. What contribution did each of the following make towards social reform ?

   St. Vincent de Paul

   St. Louise de Marillac (Mlle. Le Gras)

   John Howard

   Elizabeth Fry

   Charles Dickens
4. In what ways are the schools of nursing of today like the

deaconess' training at Kaiserswerth ?

5. Discuss the life and work of Miss Nightingale under the follow ing headings :
   (a) Her early training and home life.
   (b) Her opportunities for studying nursing and learning about hospital work.
   (c) Her work at the Crimea.
   (d) Her post-war activities.
   (e) Her permanent influence on nursing.
6. Answer the following questions briefly:
   (a) Where, when, and by whom was modern nursing estab lished?
   (b) Who was the first superintendent of nurses ?
   (c) How was this first modern nursing school financed ?
   (d) What were the principles on which the school was founded?
   (e) For what work were the Nightingale nurses prepared ?
7. Name three pioneers in nursing education in America.
8. Who was responsible for the development of Modern District nursing ?

CHAPTER 7

PUBLIC HEALTH AND PUBLIC HEALTH NURSING

PUBLIC HEALTH

The modern public health campaign began about 130 years ago with the development of new scientific discoveries. In England before 1830, no interest was taken in public health. As a result of the Industrial Revolution many people left their homes in the country and moved to the city to be near the factories. Towns and cities grew up without a plan for good housing, safe watersupply or disposal of waste matter and excreta. As a result people lived in crowded rooms with no proper ventilation, comfort or privacy. The streets were filthy and dirty. In such unhealthy conditions infectious diseases spread rapidly. Death rates were high and life expectancy was short. These conditions were investigated and reported to the government by Sir Edwin Chadwick. As a result, in 1848, the public Health Act was passed. Changes were made from time to time which brought about much improvement of the towns.

Scientific discoveries showed that to be really healthy, man needed more than a good environment. The discoveries of Pasteur, Koch, and other bacteriologists made the prevention of communicable diseases possible. Thus new laws were passed to make sure that every individual from birth, or before, and throughout life was given every opportunity to keep good health.

The reports of Sir Edwin Chadwick and others who tried to bring about sanitary reforms in England were read by Miss Nightingale and were a help to her when she worked for health reforms in the British Army Medical Services. Many of the British forces were in India. The high mortality rate in the army as well as in the civilian population came to Miss Nightingale's attention. Through her efforts in 1859 a Royal Commission was sent to India from England to find out the causes for these high mortality rates in both the military and civilian population. This Commission reported in 1863 and advised the

appointment of 'Sanitary Commissions' that in turn advised the formation of Public Health Services. Very little was done to advance Sanitary Administration until 1896 when the plague came to Bombay. The government then realised the need for a new administration. Various plans were tried. Now each state has its Minister of Health and public health is a department in the Ministry of Health and Family Planning in the Central Government.

PUBLIC HEALTH NURSING

In order that public health can be properly administered it is necessary for the public to have information about sanitation and the prevention of diseases. Education is the chief means of spreading this information. This has become the work of the public health nurses.

The earliest type of public health nursing was done by the Apostolic Deaconesses- that of visiting nursing. Miss Nightingale's doctrines regarding *health and the prevention of disease* marked the turning point from visiting nursing to public health nursing. She insisted that teaching of sanitation and hygiene be given with bedside care. (This principle of combined nursing and teaching is accepted as giving the best results in all Public Health Nursing Services.)

In the English Association formed by William Rathbone and in other visiting nurse associations the modern visiting nurse began with nursing care accompanied by teaching. The emphasis on charity and free care for poor patients was dropped and a spirit of self-respect and intelligence was encouraged in the patients. Florence Lees improved visiting nursing by her recommendations that visiting nurses be given special training for their work. From these experimental beginnings new methods have begun to help nurse the sick at home and prevent disease. New types of services have opened in various countries, requiring a large staff of workers.

Public health nursing in India is now called *Community health nursing* . The work of the modern community health nurse is done with very wide aims. Combined nursing and teaching in the home and community is done to preserve life, relieve suffering, and promote health. In order to carry out these aims, the community health nurse is active in the entire environment of the patient. This includes all

areas related to the individual such as, himself as a person (physically, mentally, socially, and spiritually), his family, his physical environment, his work, his community, his society, and his culture.

Health of the public has become a worldwide concern. Good health is even considered to be every human being's *right* . Because of this concern, many organisations have been formed to achieve this aim. The World Health Organisation

WHO is the international agency for this work and provides necessary advice and many health teaching services to individual countries. The importance of public and community health is also seen by the way in which it has become integrated into the basic education for nurses and taught as a postgraduate speciality.

QUESTIONS FOR STUDY

1. Why is Sir Edwin Chadwick remembered ?
2. Who was responsible for having the Royal Commission sent to India ? Why ?
3. What are the aims of modern community health nursing ?

CHAPTER 8

INTERNATIONAL AND NATIONAL ORGANIZATIONS

INTERNATIONAL RED CROSS

In 1859 Italy and France were at war with Austria. The battle of Solferino was being fought in North Italy. Jean Henri Dunant, a visitor from Switzerland, witnessed the battle and saw how the wounded men were left lying on the field with no one to help them. He was reminded of Miss Nightingale's work in the Crimea. He was filled with pity and sympathy and decided he must do something to help these men. He gathered together a group of volunteer women from the nearby villages and helped them to give nursing care. To all, regardless of whether they were friend or foe, they gave food and drink, did dressings, or gave whatever care was needed.

Jean Henri Dunant realised that much could be done to relieve the suffering caused by war. To this cause he dedicated his life. He suggested that each civilised country form an organisation of volunteers who would give help to wounded soldiers, of any country, in time of war.

He got the help of kings and influential men. Finally a national congress met at Geneva in 1863 to consider ways of getting volunteers. In 1864 fourteen countries signed the Treaty of Geneva. They agreed that the armies would respect military hospitals as safety zones. Doctors and nurses would be considered neutral personnel and would serve the wounded of any nationality. Each country joining would start a society to get its own volunteers.

In honour of Jean Henri Dunant and his country it was decided that the emblem or badge of the Society would be a Red Cross on a white background, just the opposite of the Swiss flag which is a white cross on a red background. The Red Cross flag flying over all hospitals became the sign of their readiness to care for the wounded of all countries, and made these hospitals places of safety, free from enemy attack.

National Red Cross Societies were quickly formed and were soon to affect nursing. Henri Dunant had suggested that volunteer nurses should be 'prepared'. The development of the Red Cross gave a new motive to women to take up the work of nursing, that of patriotism[1]. Various types of training were set up in each country. Training has progressed from the short courses for training voluntary *aids* to the regular three year nurses' courses now given by the Red Cross in many countries. The Red Cross now also sponsors postgraduate nursing programmes and speciality courses. It plays an important part in the recruitment for all types of nursing education.

Following World War 1 the Red Cross saw the need of continuous peacetime work in times of famine, floods, earthquakes, etc. This would require public health nurses.

In 1919 the League of Red Cross Societies was established to relieve suffering, prevent disease and improve health ; also, to establish training schools for the training of the public health nurses Scholarships are given to help graduate nurses qualify as public health teachers and nurses.

The Red Cross has aims which are closely related to those of the International Council of Nurses. The International Red Cross Nursing Advisory Committee includes observes from the I. C. N. Besides the aims of health and welfare of the public, the Red Cross does much to promote the importance and the social and economic status of the nurse.

INDIAN RED CROSS

During World War I gifts and monies had been received for the purpose of giving medical aid to the sick and wounded. The Indian Red Cross Society was constituted under the Government of India Act XV of 1920 to be responsible for the administration of this fund and to continue peacetime work, such as, relief of suffering, prevention of diseases, and the improvement of health.

The Indian Red Cross is interested in providing care for war [2]veterans, in maternity and child welfare, in emergency relief, in health

[1] Patriotism – loyalty to and love of one's country.

[2] Veterans -- former soldiers who had been active during war time

education for the public and in nursing education. They have also started a Junior Red Cross in the schools and colleges.

INTERNATIONAL COUNCIL OF NURSES [3]

In the end of the 19th century many organisations for political, business and social purposes were formed. This trend to form groups influenced the young nursing profession. In 1887 Mrs. Bedford Fenwick suggested to the British nurses that they form an association of trained nurses. Hence, the Royal British Nurse's Association was formed. Other countries also formed national Associations. Mrs. Bedford Fenwick was a real leader among nurses and in 1899 she suggested the formation of an International Nurse's Organisation. With the co-operation of nurses from several countries a constitution was adopted in 1900. The following year the first Council meeting was held in Buffalo, N. Y., at which time Mrs. Fenwick was elected the first president of the International Council of Nurses. Thus, the I. C. N. became the first international association of professional women. Active membership is offered to all self-governing National Nurse's Associations. At present, there are eighty-four associations in membership. Only one nurse's association may represent a country.

The functions of the I. C. N. have changed with the changing needs of the nursing profession. It functions by means of three divisions. These are : (1) the Division of Nursing Education, (2) the Division of Nursing Service, and (3) the Division of Social and Economic Welfare. The I. C. N. provides a way in which the national nurse's associations can share common aims. It helps individual countries to organise and develop national associations. It provides a means by which the nursing organisations can communicate with related health organisations on an international level. Other direct nursing functions include provision of guidelines for nursing education and practice, promotion of social and economic welfare of nurses around the world, nursing research, and general health service to the public. One of the more recent functions has been the provision of Exchange Privileges for nurses. This service provides assistance to the individual nurse in

[3] For further information see T. N. A. I. Handbook.

making arrangements for temporary employment or observation in other countries.

THE COMMONWEALTH NURSES FEDERATION

The Commonwealth Nurses Federation is made up of nurses associations from Commonwealth countries. It is governed by a Board of representatives from each Commonwealth country. The aims of this organisation are-- to promote sharing, better communication and closer relationships between its member associations. It also provides financial assistance for professional meetings and seminars, scholarship for advanced study and expert professional advice.

SALVATION ARMY

Outstanding among the new leaders was Mr. William Booth who began a mission among the poor of London, which was organised on a military basis. This army of peace gave protection to the poor, old, the young and the miserable, and has spread all over the world. Today there are hospitals and nursing schools managed by this organisation and we find outstanding nursing leaders from this group.

Y.M.C.A. AND Y.W.C.A.

The Young Men's Christian Association as a social organisation was founded in Canada and U. S. A. Then it spread all over the world. Character building, body building, recreation, education and relief work were offered to young people. In 1894 the world Young Women's Christian Association was organised. Today nurses are members of this association and participate in its activities.

MEDICAL MISSIONARIES

In 1892 an English physician named Dr. Wilfred T. Grenfell bought a ship and equipped it with all hospital materials and set out to offer medical services to people in the ice-cold region of Labrador. Doctors, nurses and others joined him to give complete health services along with spiritual care. Medical missionaries in great number spread Christ's teaching to many countries. Today we find Medical Mission Sisters managing hospitals and giving care to the sick.

THE WORLD HEALTH ORGANIZATION

WHO is a specialised agency of the United Nations and works to achieve the 'highest possible level of health' for all people. It was officially organised in 1948 for the purpose of directing all international health work. More than one hundred countries are members of this organisation. Its activities are many and varied, including the promotion of public health in all areas, nursing education, and nursing administration. Activities in India have centred on refresher courses, in-service education programmes for graduate staff, and the promotion of training for auxiliary nursing personnel.

United Nations International Children's Emergency Fund (UNICEF)

UNICEF is also a specialised agency of the United Nations. It began in 1946 for the purpose of helping mothers and children of countries involved in the Second World War. Since then, its services have been broadened to include all underdeveloped countries. It differs in sponsorship from the WHO because it is financed by voluntary contribution only. These contributions for the UNICEF may be given by governments or by individuals.

The activities of UNICEF centre upon child and maternal welfare and all education and service related to these areas. Contributions in India include provision of teaching equipment for nursing education, purchasing of nursing textbooks for schools of nursing, provision of visual aids for teaching purposes, and training of personnel to carry out programmes related to the health of mothers and children.

NATIONAL HEALTH AND SOCIAL WELFARE ORGANIZATIONS

A number of organisations have been formed in India for the purpose of meeting specific health and social needs of the public. Some have begun from a small nucleus of interested persons and later developed with the support of the government and the public. Health organisations have been helpful in the preventive, diagnostic, and rehabilitative activities related to leading health problems in India. Social welfare organisations have done much to increase public interest and promote action for the relief of serious social problems.

Tuberculosis Association of India

Tuberculosis was recognised as a major health problem in 1929 when the first attempts at group action were made. However, funds were not available to carry out health activities until 1939. In that year, an intensive appeal for an All-India Tuberculosis Fund was made and the response was encouraging. Funds were made available to form the Tuberculosis Association of India.

The most important functions of this organisation are early diagnosis, treatment , and rehabilitation of the tubercular patient as well as training of personnel. Model institutions have been established to carry out these aims. Methods of reaching the public include mass X-ray, B.C.G. vaccination , domiciliary care, sale of seals and publicity by means of radio and print. Detailed research is also sponsored by this organisation.

Hind Kust Nivaran Sangh

This organisation works for the purpose of controlling leprosy. This disease was recognised early as a serious health problem because of the disfiguring complications and negative social attitudes. The first action taken to control leprosy was by the British Empire Leprosy Relief Association (India Council) before India became independent. Activities aimed at learning more about the cause, treatment, and control of leprosy. The organisation did much to finance the first full-time leprosy research centre in the world at the School of Tropical Medicine in Calcutta.

The above activities were taken over by the newly formed Hind Kust Nivaran Sangh in 1949 after which the BELRA was dissolved. The 'Sangh' also works to increase public knowledge of the disease and to stimulate interest in the medical, public health, and social problems related to leprosy. It is doing useful work in helping to change the attitudes of the public and the members of the medical profession.

All- India Blind Relief Society

This Organisation, financed by the Government of India, was established in 1946 for the purpose of bringing together the work of

many different institutions for the care of the blind. Earlier relief work for the blind had been done by both private and government agencies, but some of it was discontinued because of lack of funds. Following surveys and the appointment of a special committee, recommendations were made to form the All-India Blind Relief Society. Since 1946, it has also provided organised health education and eye relief camps.

Family Planning Association of India

Efforts to form an organisation to promote family planning in India were made as early as 1925. These were not successful. In 1947, a group of social workers in Bombay began group activities aimed at education of the public regarding the need for family planning. Public response was encouraging. Family planning began to be recognised as most important, not only to control the rapid growth of population but also as a health measure. Activities quickly advanced to include spacing and the limitation of childbirth, help and guidance with general marriage problems, training of personnel, and research. Because of the continuing problem of population growth, emphasis is given to spacing and limitation of childbirth. However, family planning deals with any area which affects the happiness of the family.

Indian conference of Social Work

This is a professional organisation of social workers which was formed in 1948. The aims of the organisation are to promote the welfare of the professional social workers, to provide a scientific approach to social problems, to educate the public regarding social problems , and to bring together the work of all social service agencies in India. It serves to stimulate public interest in social work and social needs. Activities are related to many areas such as physically handicapped children, problems of caste, slum clearance , etc. The Indian Conference of Social Work is affiliated with the International Conference of Social Work in New York

Central Social Welfare Board

The Central Social Welfare Board, set up by the Government of India in 1953, serves to organise and assist the efforts of voluntary

social welfare organisations. It began with assisting in the improvement and development of social welfare activities related only to women, children and the handicapped. It now includes services related to others such as the aged and infirm, persons released from correctional and non-correctional institutions, rehabilitation of cured leprosy and tubercular patients, and patients in medical institutions. Financial grants are given to agencies which provide approved social welfare activities. These may include provision of hostels for working women and the handicapped, night shelters, holiday camps for school children, training in crafts and village industries, and general publicity.

QUESTIONS FOR STUDY

1. (a) Why did Jean Henri Dunant spend so much time and energy to start the Red Cross Society ?

   (b) How did Florence Nightingale influence him ?

2. (a) What nursing organisation came into being at the end of the 19th century ?

   (b) Who was the chief organiser ?

3. How does the I. C. N. influence nursing on a national and local level ?

4. (a) How are the WHO and UNICEF organisations active in nursing in India ?

   (b) What health and social problems caused the formation of national organisations in India ?

CHAPTER 9

NURSING IN INDIA

Beginning of Modern Nursing

In chapter 3, the ancient records of Indian medicine is mentioned. The leading authorities of ancient system of medicine, the Ayurveda, were Sushruta – a surgeon, and Charaka – a physician. Their writings are called Samhitas. These records are dated from 1500 B. C.

The books of Ayurveda which are in eight parts cover the whole field of medical science including nursing care. There are more details about nursing in the ancient Indian records than there are in records of any other country in the world.

The ancient Hindus laid more emphasis upon the prevention of diseases rather than upon its cure, an attitude that has gained ground again in 20th century. Sushruta defines the ideal relationship between doctor, patient and nurse. Medicine was considered as the four feet upon which a cure must rest. The following reference to a nurse is found in Charaka-Samhita Chapter IX.

Nurse: *Knowledge of the manner in which drugs should be prepared or compounded for administration, cleverness, devotedness to the patient waited upon and purity (both of mind and body) are the four qualifications of the attending nurse".*

The most advanced period of medicine in ancient India was from 250 B. C. to 750 A. D. As mentioned in chapter 3, the deterioration which set in since then devastated the professional practice of medicine. About 1000 A. D. public hospitals disappeared. It took centuries to revive the practice of institutional care of the sick. It began with the care for the sick among the British army.

From time to time various races, languages and religions took root in India. Along the east and west coasts of India, in the 16th century Portuguese and French settlements were added. We have very little information about medicine and nursing in India until the 15th century

when Vasco da Gama came to India. He set up trading posts on the west coast. Franciscan, Dominician and Jesuit missionaries came to minister to the sick and needy.

The Portuguese set up European type of dispensaries at Goa and Madras. Physicians were invited from Europe to India. One of these, Garcia da Orta in 1550 wrote 'simples and drugs of India'.

The conquests and settlements of the British in India consummated in the establishment of her direct rule over many areas and protectorate rule over feudatory states. From Himalayas to Ceylon (now Srilanka) the Peninsula was divided into Provinces and Presidencies. There were the Northwest Provinces, the Punjab, the Rajputanas, Indore Agency, Central Provinces, Bombay Presidency, Bengal Presidency, Madras Presidency and Ceylon.

DEVELOPMENT OF HOSPITALS AND NURSING SERVICES

By the end of 19th century there were four types of hospitals which came into existence. They were military hospitals, civilian hospitals, hospitals where European religious orders provided nursing staff and Protestant mission hospitals. Medical colleges were established in Madras, Bombay and Calcutta and Western medicine was well accepted.

MILITARY HOSPITALS

In 1664 the East India Company helped to start a hospital for soldiers at Fort St. George, Madras. Military hospitals were started in other parts of the country. Nursing in military hospitals were carried on by soldiers, male orderlies and the menial staff.

CIVILIAN HOSPITALS

The need for attending to women during childbirth was felt by the colonial authorities as they noticed the heavy mortality among Indian women during childbirth. Lying-in hospitals in Calcutta were established. In 1844, the lying- in hospital in Madras was started. In Bombay in 1843 the first hospital of Jamsetjee Jeejeebhoy group of hospitals was started. Government appointed European nurses as matrons to carry out the nursing care in these hospitals. Pupils who were admitted to learn midwifery and medical students assisted them.

DUFFERIN HOSPITALS

Although in the late 19th century lying-in hospitals were functioning they were over crowded. Most of the upper caste women could not make use of the medical facilities because of caste and fear of pollution. There were not enough women doctors or nurses to attend to them in homes. A message was sent by Maharani of Poona to Queen Victoria to inform her of the suffering of Indian women when they were sick. The Queen asked Lady Dufferin who was accompanying her husband to look into the problem. Lady Dufferin was able to raise money from friends and affluent people for the medical education of women. In 1885, The National Association for supplying Female Medical Aid to the women of India was established. This is called the Dufferin Fund. Initially the money was used for educating women physicians and later for training of nurses and midwives. Many women's hospitals with nurses and midwives training schools attached, were aided by this fund.

HOSPITALS RUN BY CATHOLICS OR OTHER RELIGIOUS ORDERS

For the J.J. group of hospitals, the government invited sisters of the Community of All Saints to come from England to take over the nursing. The sisters of the Holy cross from Switzerland were invited by the Maharaja of Travancore. Their devoted and sacrificial work contributed much to the development of nursing in the former princely state of Travancore as well as other centres in India.

PROTESTANT MISSION HOSPITALS

By the middle of 19th century many missions and denominations of Christianity had founded their stations in various parts of India. Many of the missionary centres served the communities around them in teaching and treating the sick. By the end of 19th and early 20th centuries many of them established mission hospitals. Most of these hospitals had qualified European or American nurses in charge of nursing services.

As nursing education progressed into the present standardised course, the delivery of nursing care in the above mentioned type of

hospitals underwent a number of changes. The nursing services in hospitals of British India began with nursing care by soldiers, orderlies and medical students. It continued with deaconesses and sisters who were non-professional but discharged the duties of a nurse out of devotion and dedication as part of Christian commitment. This was followed by western nurses with professional qualifications who envisaged the improvement of nursing education and growth of Indian nursing leadership. It has been well pursued by Indian nurses who were trained and nurtured under these predecessors to become today's leaders.

NURSING EDUCATION

While the lying-in hospitals were established in the 1840's the training of midwives was a crying need in India. Many missionaries of 19th and early 20th centuries who witnessed the outcome of indigenous midwifery practices have described the services of dais as barbarous. The fatal outcome of crude and unscientific methods of an attending traditional dai was an accepted catastrophe among the Indians. In those days the parturient women were considered to be impure and polluted. So they were attended by traditional birth attendants who were uneducated women of low class and caste. In the caste hierarchy they were at the lowest level and therefore midwifery was not a lofty profession.

The first midwifery students of Calcutta and Madras were Europeans or Anglo-Indians. Training of native midwives began later in the lying in hospitals in Calcutta and Madras and also in the Dufferin hospitals. Innumerable number of western Christian women who were doctors, nurses or midwives came to India in the late 19th century to take up educational and medical missionary work. Their self-sacrificing efforts in improving literacy among Indian women and introducing western obstetric methods were magnanimous.

Social Reforms such as banning of Sati, widow re-marriage act, child marriage restraint Act, Age for consent etc. brought about considerable changes in the status of Indian women. Many Indian women who were able to receive education rendered their services to Indian women in training midwives and encouraging women to take up nursing.

As the attendance in many of the hospitals improved the need for training nurses for nursing care of patients in hospitals was felt. Initial nursing training was given for orderlies or midwives for two to six months of closely supervised clinical experience. Later this pattern of training midwives into nurses reversed. As there were problems of caste and pollution it was difficult for Indian women to take up such a training as nursing. With the establishment of British rule 'Christian Missions' advanced the spread of Christianity bringing civilising and elevating influences of education, science and inventions. The 19th century missionaries were of high educational background. Their emphasis on education helped in advancement of school and college education. Female education was promoted by missionaries. Christian girls did not suffer much from restrictions of caste and pollution. They were more at liberty to receive education and have late marriage. While women of other communities lagged behind, Christian women were able to receive sufficient education to join the few professional courses available for women at that time. For decades even after independence the number of Christian girls available to take up nursing profession was indomitable.

The basic programme for combined general nursing and midwifery developed rapidly after 1871. The need for theory as well as practical experience was felt. The training for general nursing was extended to two years and then three years before the student went on for midwifery training.

By the end of 19th century a large number of training schools which belonged to the various mission hospitals were started. In 1908 the nursing superintendents of India who were Europeans or Americans formed Trained Nurses Association. They called the attention of the 'Medical Missions' of India to standardise the training schools for nurses, attached to their mission hospitals in India. In 1911, a nursing committee was formed by South Indian Medical Missionary Association. This committee stipulated the training period and curriculum. It has been the precursor of the present Board of Nursing Education South India Branch and Mid India Board of Examiners of Nurses League, CMAI. Much of the pioneering work in upgrading of curriculum, improving methods of examination and setting standards for training

schools has been done by these Boards. They also provided the basis for establishing the Indian Nursing Council.

The present basic programme for nursing education throughout India consists of a three-year programme in general nursing and midwifery. Uniformity of training is maintained by recognition of schools, which meet the standards and requirements given by the Indian Nursing Council. The basic certificate programme now includes all areas of nursing as well as integrated community health nursing.

The leaders of nursing in India realised that more and better-qualified teachers and ward supervisors were needed if standards were to be maintained and nursing was to advance. Hence, courses were set up in several places to give Indian nurses an opportunity to prepare themselves for responsible positions in hospitals and schools of nursing. Post-certificate courses were first offered in Nursing administration, supervision, and teaching. These originated at the College of Nursing, New Delhi ; the College of Nursing, C. M. C. Hospital, Vellore ; and the Government General Hospital, Madras.

The first four year basic Baccalaureate Degree programme was established in 1946 at the Colleges of Nursing in Delhi and Vellore. In 1963 the School of Nursing in Trivandrum instituted the first two-year post-certificate Bachelor Degree programme. The first Master's Degree course, a two-year postgraduate programme, was begun in 1960 at the College of Nursing in Delhi in India. Today there are 12 institutions which offer Masters programme in nursing. M. Phil in Nursing is offered at RAK College of Nursing Delhi and College of Nursing M.A.H.E. Manipal Ph.D. programme is also available in M.A.H.E Manipal, Institute of health sciences, Mangalore and College of Nursing Vellore.

AUXILIARY NURSING

The use of auxiliary nursing personnel to ease the shortage of professional nurses had been common in some countries before it was first put into practice in India. A two-year programme for the Auxiliary Nurse-Midwife was first established in 1951 at St. Mary's Hospital, Taran Taran in Punjab State. By 1962, there were 263 schools offering this course in India. In 1977 the ANM curriculum was revised by the

Indian Nursing Council to begin the Multipurpose Health Worker Scheme. Most States have adopted the revised ANM course usually termed as Health Worker (Male and Female) course. In the health care delivery system the health workers play a vital role in providing health services in the rural area. Among the three components of nursing, (Curative,promotive & preventive), a lion's share in prevention and promotion is carried out by Health Worker (F).

REGISTRATION OF NURSES

As training for nurses, midwives, and health visitors progressed, the need for legislation to provide basic minimum standards in education and training was felt. It was also felt that registration would give greater professional status. For some years nurses struggled to obtain proper examinations and examiners and registration for nurses. In 1926 Madras State formed the first Registration Council. There are nineteen state nursing councils now which register those who have successfully completed the respective curriculum. It is essential for the various 'nursing personnel' such as general nurses (diploma or degree) ANM or HW to be registered with a state nursing council.

STATE REGISTRATION COUNCILS

The training of nurses, ANMS or HWs and health visitors is to a large extent controlled by the nurses' registration councils in each state. State councils are to inspect and accredit schools of nursing in their state, conduct examinations, prescribe rules of conduct, take disciplinary action etc. The maintenance of registers of nurses, midwives ANM or HW and health visitors is also the responsibility of State Nursing Councils.

THE INDIAN NURSING COUNCIL

The Indian Nursing Council Act was passed by an ordinance on December 31st 1947. The Council was constituted in 1949 to establish a uniform standard of education for nurses, midwives, health visitors and auxiliary nurse midwives. The INC has power to prescribe regulations and syllabi for various training courses, to recognise examining bodies and to negotiate reciprocity. The mutual recognition

by the State Nurses Registration Councils is called reciprocity. The Indian Nursing Council is neither a registering body nor examining body but it can enforce its standards by recognising or refusing to recognise schools.

COMMUNITY HEALTH NURSING

In India community health nursing had its beginning when the terrible conditions under which children were born were recognised as a cause for the high civilian mortality rate. It was realised that the untrained dais who attended women at childbirth must be given training. This was not an easy job as the dais were unwilling to be trained and the patients were very willing to accept the old customary methods and could see no need to change. The first attempts to train dais were carried out by missionaries as early as 1886. In 1900 Lady Curzon brought about the establishment of the Victoria Memorial Scholarship for the purpose of improving childbirth conditions. The need for training a better type of midwife was felt. In this, Madras State led the way when they passed the Madras Registration of Nurses and Midwives Act of 1926.

Slowly the need for trained personnel for maternal and child health, as part of community health nursing, was felt. To supply this need a Health School for the training of Health Visitors was started in Delhi in 1918. This has now become the Lady Reading Health School. (See Handbook of T. N. A. I., page 67).

A further step forward was taken in 1946 when community health nursing was integrated[1] in the basic programme of the new degree courses which were started at the College of Nursing, Delhi and the School of Nursing, C. M. C. Hospital, Vellore, under the University of Madras.

Since 1953 a post-certificate course in community health nursing is being conducted at the All-India Institute of Hygiene and Public Health in Calcutta. In 1960 this course was introduced by the Lady Reading Health School in Delhi. Several other schools now offer this programme.

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[1]Integrated-- to bring the parts together into one whole

To prepare more community health nurses, in 1957 the Government of India selected ten schools of nursing and gave assistance so that they could integrate community health nursing into their basic course. Since that time, recognition of a programme of basic nursing education required that community health nursing be integrated into the basic course. Thus, all professional nurses today can function in the hospital and in the community health department at the level of a staff nurse.

Various international organisations, such as WHO., TCM and Colombo Plan have assisted by supplying trained personnel and equipment to help in the training of students in the rural field, maternity work and paediatrics.

NURSING ORGANIZAIONS

In the early 20th century many countries established National Nursing Associations. The following is a short outline of nursing and [2]auxiliary associations in India.

Trained Nurses Associations of India

As hospitals and schools of nursing developed, the matrons felt the need of joining together in an association whereby they could meet and discuss their problems. Also, by joining together they felt they could raise the status of nursing in this country, and so in 1905 the European matrons formed the Association of Nursing Superintendents.

In 1908 the Trained Nurses Association or India was formed as it was felt that other graduate nurses were needed to uphold the dignity and honour of the nursing profession. The Honourable Florence Macnaughton was the first President. In 1912 the TNAI became affiliated with the ICN In 1917 it was officially registered under the Societies Act XXI of 1860. The two associations worked together until 1922 when they joined together under the title " The Trained Nurses Association of India. The head office is located in New Delhi. The official [3]organ of the TNAI is The Nursing Journal of India, which is published monthly.

[2]Auxiliary--helping or related
[3]Organ--way of making known the official acts and opinions of an organization

The association has established within its jurisdiction the following organisations: Health visitors' League – in 1922, Midwives, & ANM association in 1925 and Student Nurses' Association 1929-30.

Affiliations – the association has accepted other nursing associations within its fold. These affiliated bodies are –

a) Nurses League of CMAI.

b) Catholic Nurses Guild of India.

c) Emmanuel Hospital Association.

TNAI is affiliated to some organisation such as

a) Commonwealth Nurses Federation.

b) National Institute of Public co-operation and Child Development.

c) National Council of Women in India.

d) International Council of Nurses.

TNAI is an associate member of certain other associations and societies doing good work in their realm of concern. Such as :

a) Voluntary Health Association of India.

b) Indian Medical Association of India.

c) Indian Red Cross Society.

d) Tuberculosis Association of India.

e) Leprosy Association of India.

f) National federation of Indian Women.

g) All India Women's Conference.

Other Voluntary Professional Organisations.

Nurses' League of Christian Medical Association of India:

It was founded in 1931 as Nurses' auxiliary of CMAI. At first it included members from Pakistan, Burma and Ceylon. The nursing superintendents of mission hospitals wanted to be able to consult

together regarding the training and registration of nurses in their hospitals and to provide a fellowship for all Christian nurses. It became affiliated with the TNAI in 1936. In 1964 the organisation changed its name to the present one.

The Mid-India Board of Examiners and The Board of Nursing Education South India, of Nurses' League, CMAI have been set up for the training of nurses. The INC recommended syllabus is followed by them. The diplomas awarded by these examining bodies are recognised by the states concerned and Indian Nursing Council. Members of this organisation have contributed to professional nursing by writing and translating nursing textbooks in English, Tamil, Telugu, Urdu and Hindi.

Catholic Nurses' Guild of India :

This is an organisation formed in response to a call made by Pope Pius XII in 1956 to unite all catholic nurses into a Guild. It provides moral protection and enables the members spiritually, professionally socially and economically. 'The Lotus and the Lamp' is the national magazine of CNGI.

Evangelical Nurses' Fellowship of India :

It is a movement begun in 1946 by nurses who firmly believed that spiritual care is an integral part of comprehensive nursing, as man is essentially a biological, psycho-social and spiritual being. 'Nurses Link' is the official publication issued bimonthly by ENFI.

Nursing Research Society of India:

It was established in 1986 to promote research within and around nursing environment. Membership is open to nurses having post graduate qualifications. The first newsletter was released in July 89.

Satellite Conference of Neuro-nurses of India :

This originated as a subsection of Neurological Society of India in 1979. The main objective of the association is to set high standards of neuro- nursing in the country. The conferences of the association is

held as part of the annual conference of NSI. They provide a forum for nurses working in neuro centres to discuss and work out solutions for their problems.

The Academy for Nursing Studies :

It is an organisation that aims at improving the quality of nursing in India. It started in 1993 and is located at Hyderabad. "The Indian Journal of Nursing and Midwifery " is the official publication of the organisation.

Indian Association of Critical Care Nurses :

Challenges of Nursing profession in India :

Since ancient days, nursing has been known as a women's profession. The social and cultural background which sets the expected behaviour of women in India, has influenced the profession also. As discussed earlier, the slackness in education of girls and social and religious traditions regarding the role of women have hindered the growth of nursing into an autonomous profession. The pioneers who withstood the social stigma attached to nursing, helped in advancing the profession to its present status. A vast majority of these pioneers were able to do so, as they had taken up nursing as a religious vocation. Post independence changes in social status of women and the self sacrificing efforts of the pioneers have brought about considerable improvement in nursing education and remarkable change in the image of nursing.

Over the past 50 years in India, three different specialisations are observed. There are generalist nurse, the nurse clinician and specialist nurse. In its early years of growth, nursing had moved to non-clinical specialisation. Nursing leaders took up specialisation in education and administration. Even today, highly qualified nurses opt to be educators. This trend may be due to inadequacies in practice-based knowledge and lower levels of autonomy.

Since the Alma-Ata declaration by International conference of Primary Health Care in 1978, the focus of health care delivery system of the country is basically on primary health care. Although giant

leapshave been made in information technology and globalisation, the Indian Society is a scenario of serious contrasts. While latest health care facilities are within the reach of the affluent, there is a vast majority who do not receive the services because of ignorance, unaffordability and illiteracy. Several crucial health indicators show that in areas where there is wider spread of education and literacy, greater degree of social equality in status and education of women and a deeper political awakening, the people have greater capacity to take care of health problems and make use of available health services.

The services of nursing profession are therefore more immensely needed both qualitatively and quantitatively to provide primary health care. The pressure is on to provide increased number of nursing personnel at all levels and in all cadres.

The rapid advancement in medical sciences and technology has demanded changes in academic and technical skills of the traditional registered nurse of missionary era. It has promoted the development of more specialised and specific functions in the health team of hospital setting. It has also added to the number and kind of professional relationships which must be maintained by the nurse.

As technology tends to take away nurse from bedside, the core function of caring with which the nursing profession is well identified is getting blurred. It is essential to maintain the quality of nursing with sufficient orientation to service and care to individuals, families and communities and sound awareness of national goals.

Nursing today provides an ever-widening scope of opportunities for service. With present trends leading towards greater opportunities, varieties of service and growing social and professional recognition, it should be exciting and challenging for you to know that you are a member of this profession.

As you learn to live selflessly and work together to build up this new spirit we become a lasting force in national life- a force for healing and uniting, a force for moral strength and, therefore, the initiator of a new quality of health.

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PART II

NUTRITION

CHAPTER 1

SCIENCE OF NUTRITION: RELATION OF FOOD TO HEALTH

INTRODUCTION

Adequate nutrition is a basic component of health. Mankind eats to satisfy the feeling of hunger, which is a sensation with which all animals are born. All are given this sensation of hunger so that they may make an effort to get food, which will keep them alive. Animals seem to know without being taught what foods they need to keep healthy. Man, however, has lost this power to choose the right food and must be taught the values of different foods so that he may choose the best.

Nurses are concerned with more than just keeping themselves alive. They want to have radiant health full of life and energy . They want to be living examples to their patients. In order to do this they have to learn and teach what to eat so that the body may be built up and supplied with energy and protection, which is necessary to prevent and overcome disease. Therefore, every nurse should and must be anxious to understand this subject of nutrition.

Nutrition deals with the way in which the human body receives and uses all the substances or materials necessary for its growth and development and for keeping it in good condition. This begins with eating food. The food is swallowed, then digested as it is passed through the stomach and small intestines. During digestion the food is broken up into simple substances. These are absorbed into the blood stream and carried to the liver, where they are either stored or changed further, or sent out to other parts of the body for use as required. Some are used to supply the body with heat and energy, others for building and repairs of the tissues and yet others are used to control the chemical changes taking place in the body, or to protect the body from disease. Finally the waste products which cannot be used are excreted.

Nutrition, is all of the processes or activities by which the human body receives and uses all the food necessary for its growth, development, regulation and repairs. From this definition we can see that Food is any substance which can be used by the body for these purposes.

1. Nutrients or constituents of food

All people are familiar with food, but in order to understand how different foods are used in the body it is necessary to know what substances or materials are present in foods. These substances are called nutrients. The nutrients present in foods are carbohydrates, proteins, fats, mineral elements and vitamins.

Dietetics is the word used to describe the practical application of the principles of Nutrition to the human body in health and disease.

2. Classification of foods

The dietary constituents of food are proteins, fats, carbohydrates, vitamins, minerals and water. Almost all foods contain all these factors but in varying proportion. Proteins, fats and carbohydrates are often termed proximate principles. Together with water they form the main bulk of food. The human body is built up from these six constituents and has the following approximate composition.

TABLE 1

COMPOSITION OF HUMAN BODY

Water	63%
Protein	17%
Fat	12%
Minerals	7%
Carbohydrates	1%

Foods are grouped on the basis of functions.

1) Energy yielding foods:

These are foods rich in carbohydrate and fat.

E.g. cereals, sugar, roots and tubers.

2) Body building foods:

Foods which are rich in proteins.

E.g. meat, fish, milk and pulses.

3) Protective foods:

These foods are rich in proteins, vitamins and minerals.

E.g. milk, eggs, green leafy vegetables, fruits etc.

The main functions of food are:

1) The provision of heat and energy for work and play.
2) Body building and repair.
3) Maintenance and regulation of tissue functions.
4) Control of body processes and for protection of the body.

As a source of energy, food for the human body may be compared to petrol for a car or steam for an engine. Without petrol the car will not go; without steam the engine will not move; when a man goes without food for one or two days he feels weak, lacking in energy and unable to work. The function of providing energy is carried out mainly by carbohydrates and fat, though protein may also be used.

To build a new car, entirely new parts must be put together. If one part wears out it must be replaced by a new part. In the human body, constituents or food elements are essential for the building of new parts, i.e., for the growth of the body, and for repairs or renewal of parts which are worn out. Protein and mineral elements are the main essential food constituents necessary for growth, repair and maintenance of the body.

All machinery needs lubrication or oiling in order to run smoothly and to prevent friction, which would cause damage. Supplying the body with sufficient food constituents for adequate growth, repair and energy is not enough. The body still needs other nutrients to regulate the various processes; some for growth; others for the

production of energy and still others to protect the body from disease. Protein and mineral elements along with vitamins help towards the third function of food.

In the study of nutrition it is necessary to consider each nutrient not only separately, but also in relation to all other nutrients and to the three main functions of food. There are very few foods, which contain only one nutrient. Most foods contain several nutrients but there is no single food found in nature, which contains ***all*** the nutrients essential for the body.

The relationship of the various nutrients to the main functions of food may be listed thus:

1. Food for heat and Energy:	Carbohydrates, Fats, Proteins.
2. Food for growth and repair:	Protein, Mineral elements.
3. Food for regulation and protection:	Proteins, Mineral elements, Vitamins.

QUESTIONS FOR STUDY

1. What do you want to learn from your study of nutrition?
2. What are the essential food constituents or nutrients and what is the function of each in the body?
3. List some of the commonly accepted ideas about foods which are not scientifically true?
4. How would you try to convince a person to change his wrong or superstitious ideas about food?
5. In what ways will good food affect health?
6. Think of a person you know who is healthy and strong because of good nutrition. How has good food helped him?
7. Why is it important to teach school children good food habits?
8. Plan a poster to show the relationship between food and health.

CHAPTER 2

CLASSIFICATION OF FOODS

Energy may be defined as the power to do work, and the word may be applied to machines or to living tissues. The final source of energy in the universe is the sun but the energy, which reaches the earth, may be stored and released in various ways.

STORAGE AND MEASUREMENT OF ENERGY

The heat of the sun on water causes evaporation and the water vapour rises and forms clouds from which, under suitable conditions, rain falls. The water running into streams and rivers, may be used to turn wheels for the production of electricity, which may be converted or changed into light in an electric bulb, sound in an electric bell, heat in a stove, or motion in an electric train. The sun's energy, may also be stored in living tissues, as in the starch formed in plants from carbon dioxide and water by the action of chlorophyll in the presence of light. Plants are used as food for animals and human beings and so supply energy for the body processes and activities.

The different forms of energy can be measured in different ways but, as all forms of energy can be converted into heat, it is often convenient to measure energy as heat. The unit for the measurement of heat is the Calorie. The Calorie (usually spelled with a capital 'C') is the amount of heat required to raise the temperature of 1 kilogram of water (1000 gm.) through 1 centigrade. Another unit which is also used is Joule which can replace the Calorie. A Joule is a very small unit, so the term kilojoule (1000 joules) is used.

1 Calorie = 4.184 Kilojoules (kJ)

If we wish to convert Calories to Kilojoules we must multiply the Calories by 4.184 or approximately 4. The term megajoule (million Joules) is also used.

If a man required 2500 Calories per day, this is equal to 10,000 Kilojoule. To be more accurate it is **4.18 x 2,500 Calories** or 10.45 megajoules.

METABOLISM

When food is eaten it is digested in the gastrointestinal tract so that it is broken down into substances simple enough to be absorbed into the blood stream. These substances are then carried to various parts of the body where they are used for building up and repairing tissues (anabolism) or they are broken down further to produce energy (catabolism).

Metabolism (from the Greek word metabole, meaning changes) in nutrition is the general name given to the changes which take place in nutrients from the time of their absorption until they have reached the end products of the various processes through which they pass.

Metabolism of protein, carbohydrate and fat in the body means the way in which these nutrients are changed. Many of the processes are very complicated, but the total of all these changes causes the release of energy. The expenditure or using up of the energy in the body is known as *Energy Metabolism*.

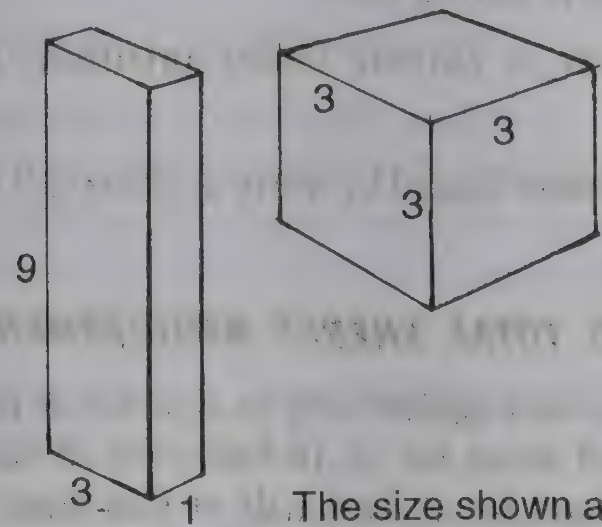
ENERGY REQUIREMENTS IN MAN

Every activity of the body requires energy. Even maintaining the vital processes such as respiration and circulation needs energy as well as do activities such as moving about or doing any physical work. The harder the physical work done, the greater is the amount of energy required by the body. On the other hand, the less work done, the smaller is the amount of energy required. When the body is at complete rest the energy requirement is at its lowest. This is called the **Basal Metabolic Rate,** which is the amount of energy required by a person who is awake but is as nearly as possible at complete mental and physical rest and has had no food for 12 to 14 hours. The Basal Metabolic Rate never goes down to zero during life because of the energy required for respiration and circulation.

FACTORS AFFECTING THE BASAL METABOLIC RATE

There are many factors which affect the Basal Metabolic Rate, the most important of which are:

1. Surface area of the body: The larger the surface area of the body in relation to its bulk, the greater is the heat lost by radiation. Compare the two objects shown in the figure.



The size shown are in cms.

The rectangular block has sides measuring 9 cm., 3cm. and 1 cm. The cube has all sides measuring 3 cm. Both objects have the same volume of 27 cu. cm., but the rectangular block has a surface area of 78-sq. cm. While the cube has a surface area of 54 sq. cm. Thus a tall thin man (illustrated by the rectangular block) will have a greater surface area to the body than a short fat man (illustrated by the cube), and he will lose more heat by radiation and his Basal Metabolic Rate will be higher. This may explain, at least in part, why a thin man often eats more than a fat man of the same weight.

2. Sex: The Basal Metabolic Rate is higher per sq. metre of body surface area in men than in women. According to Western standards, the requirements are:

40 Calories per sq. metre per hour for men.

37 Calories per sq. metre per hour for women.

Experiments in India show that young South Indian Women have a Basal Metabolic Rate averaging 17 percent lower than Western standards.

3. Age: Growing children and adolescents have higher Basal Metabolic Rates in relation to their weight than adults.

4. Diseases: Some diseases, especially of the thyroid gland, may raise or lower the Basal Metabolic Rates. A rise in body temperature of one degree (Fahrenheit) is found to increase BMR by about 7 %. This is important to remember during fever.

5. Under prolonged or chronic under-nutrition, the BMR is decreased.

6. Psychological tension caused by worry or stress will increase the BMR.

FACTORS AFFECTING TOTAL ENERGY REQUIREMENT

The Basal Metabolic Rate applies only to a person at rest, whereas most adults are up and about for 14-16 hours out of each 24 hours and may be working hard for at least half of that time. This extra activity results in an increase in the using up of energy depending upon the type of work done.

Total Energy Metabolism is a measure of the total amount of energy required during 24 hours, whether the person is resting or working and therefore includes the Basal Metabolic Rate plus the extra energy required for activity during waking hours. The relationship of Basal Metabolic Rate to Total Energy Metabolism in the average moderately active man is approximately 1:2.

There are certain factors, which influence the Total Energy Metabolism in the normal human being.

1. *Weight*: Total Metabolism includes work done in moving one's own weight from place to place. Therefore, the heavier the individual, the more energy is required for movement.

2. *Specific Dynamic Action of Food*: It has been found by experiment that there is an increase in the production of energy in the form of heat after taking food. This is not due to any work done in digestion or absorption but is due to an effect of food on the Basal Metabolism. This is known as the Specific Dynamic Action of food and the stimulating effect varies according to the different nutrients.

Specific Dynamic Action of Carbohydrates	5-6%
Specific Dynamic Action of Fats	4%
Specific Dynamic Action of Protein	30%
Specific Dynamic Action of Mixed diet	12%

This means that to maintain the weight of a sedentary person it is necessary to supply as mixed diet 12 percent more food than basal requirement. It should be noted again here that the figuring of Basal Metabolic Rate is done after all food has been absorbed, when there is no Specific Dynamic Action of Food.

3. *Age*: Age also affects Total Metabolism, e.g., adolescents require more total energy than adults.

4. *Temperature*: The body must have sufficient food to make up for heat loss. The amount of heat lost from the body depends on two main factors:

(i) *The amount of work done*: The more active a person is, either at work or play, the more heat is produced, and this must be eliminated or removed from the body.

(ii)*External temperature*: The greater the difference of temperature between the body and the surrounding atmosphere, the greater will be the heat lost from the body. If a person is exposed to cold without doing work, he will need extra food to provide heat to keep up the body temperature. In India in the hot season the difference in temperature between the body and its surroundings is very small or surrounding temperature may even be higher than the body temperature. People, therefore, try to increase the heat lost from the body by sitting in the breeze or sitting under the fan. In colder regions people try to prevent heat loss from the body by putting on more clothes or heating their houses.

5. *Muscular activities*: In the U.S.A. it has been estimated that the energy used up under different conditions of muscular activity are as follows:

Form of activity	Calories per hour for 70-kg man
Sleeping	65
Awake lying still	77
Sitting	100
Standing relaxed	105
Dressing and undressing	118
Sweeping	169
Walking 4 km per hour	200
Bicycling, moderate speed	245
Walking 6 km per hour	300
Walking downstairs	364
Swimming	500
Running 8.5 km per hour	570
Walking upstairs	1,100

There is as yet no evidence or proof that mental work causes any increase in metabolic rate.

6. Pregnancy: During pregnancy energy requirements are increased due to growth of foetus, placenta, increase in size of uterus and breasts, as well as increase in blood volume. The increased weight of the woman, also mean an increase in energy required to carry the load. The requirement is more (15-20%) during the latter half of pregnancy.

BALANCED DIETS

(as revised in 1981)

	Man	Adult		Woman	Adult		Children		Boys	Girls
Food Item (gms/day/head)	Sedentary	Moderate work	Heavy work	Sedentary	Mode-rate work	Heavy work	1-3 years	4 – 6 years	10 – 12 years	10 – 12 years
Cereals	460	520	670	410	440	575	175	270	420	380
Pulses	40	50	60	40	45	50	35	35	45	45
Leafy Vegetables	40	40	40	100	100	50	40	50	50	50
Other Vegetables	60	70	80	40	40	100	20	30	50	50
Roots and tubers	50	60	80	50	50	60	10	20	30	30
Milk	150	200	250	100	150	200	300	250	250	250
Oil and Fat	40	45	65	20	25	40	15	25	40	35
Sugar or Jaggery	30	35	55	20	20	40	30	40	45	45

Recommended Dietary Intakes of Nutrients

Group	Particulars	Net calories (kcal)	Proteins (g)	Calcium (g)	Iron (mg)	Vitamin-A: Retional (μg)	or	Vitamin-A: β-carotene (μg)
Man	Sedentary work	2400	55	0.4 0.5	24	750		3000
	Moderate work	2800						
	Heavy work	3900						
Woman	Sedentary work	1900	45	0.4-0.5	32	750		3000
	Moderate work	2200						
	Heavy work	3000						
	Pregnancy (second half of pregnancy)	+300	+14	1.0	40	750		3000
	Lactation							
	0-6 months	+550	+25		32	1150		4600
	6-12 months	+400						
Infants	0-6 months	118/kg.	2.0/kg	0.5-0.6	1.0 mg/kg	400		
	6-12 months	108/kg	1.7/kg			300		1200
Children	1-3 years	1220	22.0	0.4-0.5	20.25	250		1000
	4-6 years	1720	29.4			300		1200
	7-9 years	2050	35.6			400		1600
Boys	10-12 years	2420	42.5	0.4-0.5	30-25	600		2400
Girls	,,	2260	42.1					
Boys	13-15 years	2660	51.7	0.6-0.7	25	750		3000
Girls	,,	2360	43.3		35			
Boys	16-18 years	2820	53.1	0.5-0.6	25	750		3000
Girls	,,	2200	44.0		35			

National Institute of Nutrition, Indian Council of Medical Research,

(as revised in 1981)

Thiamine (mg)	Riboflavin (mg)	Nicotinic Acid (mg)	Vitamin B_6 (mg)	Ascorbic acid (mg)	Folic acid (μg)	Vitamin B_{12} (μg)	Vitamin D (I.U.)
1.2 1.4 2.0	1.4 1.7 2.3	16 19 26	2.0	40	100	1	
1.0 1.1 1.5	1.1 1.3 1.8	13 15 20	2.0	40	100	1	
+0.2	+0.2	+2	2.5	40	300	1.5	
+0.3 +0.2	+0.3 +0.2	+4 +3	2.5	80	150		
59μg/kg 54μg/kg	71μg/kg 65μg/kg	780μg/kg 710 μg/kg	0.3 0.4	20	25	0.2	
0.6 0.9 1.0	0.7 1.0 1.2	8 11 14	0.6 0.9 1.2				
1.2 1.1	1.5 1.4	16 15	1.6	40	100	0.2- 1.0	200
1.3 1.2	1.6 1.4	18 15	2.0				
1.4 1.1	1.7 1.3	19 15	2.0				

Hyderabad, India.

SUGGESTED SUBSTITUTION FOR NON – VEGETARIANS

Food item which can be deleted in non-vegetarian diets	Substitution that can be suggested for deleted item or items
50% of pulses (20-30g)	1. One egg or 30g of meat or fish. 2. Additional 5g of fat or oil
100% of pulses (40-60g)	1.Two eggs or 50g of meat or fish or one egg + 30g of meat or fish. 2. 10g of fat or oil.

ADDITIONAL ALLOWANCES DURING PREGNANCY AND LACTATION

(as revised in 1981)

Food items	During pregnancy	Calories (Kcal)	During Lactation	Calories (Kcal)
Cereals	35g.	118	60g.	203
Pulses	15g.	52	30g.	105
Milk	100g.	83	100g.	83
Fat	—	—	10g.	90
Sugar	10g.	40	10g.	40
Total	—	293	—	521

QUESTIONS FOR STUDY

1) Where does energy for human use originally come from? How is it changed and stored to become useable by humans?
2) How is heat energy measured?

3) What is meant by metabolism? What two processes are included in it? At what stage in the changes of food does metabolism begin?

4) What is meant by energy metabolism?

5) What factors might make the basal metabolism of two adults of the same age as different?

6) Explain how the following factors affect the total energy requirement of an individual: muscular activity, weight, food, and external air temperature.

7) Why would you expect the caloric requirement of many poor people to be higher in cold weather than that of people who have more money?

8) Is it reasonable to eat less in the hot weather than in cold weather? Why?

9) What are your calories needs per day according to the table on page 98 approximately?

CHAPTER 3

FOOD WHICH SUPPLY ENERGY

The relationship between the various nutrients and the main functions of food have been summarised in the earlier chapter. Any food may contain one or more nutrients, but carbohydrates, fats and protein are the nutrients which give Calories to the body. The Calorie value of these nutrients and of many common foods has been determined by burning a known weight of the nutrient or food in an atmosphere of oxygen in what is known as a Bomb Calorimeter. From this we learn the following approximate figures:

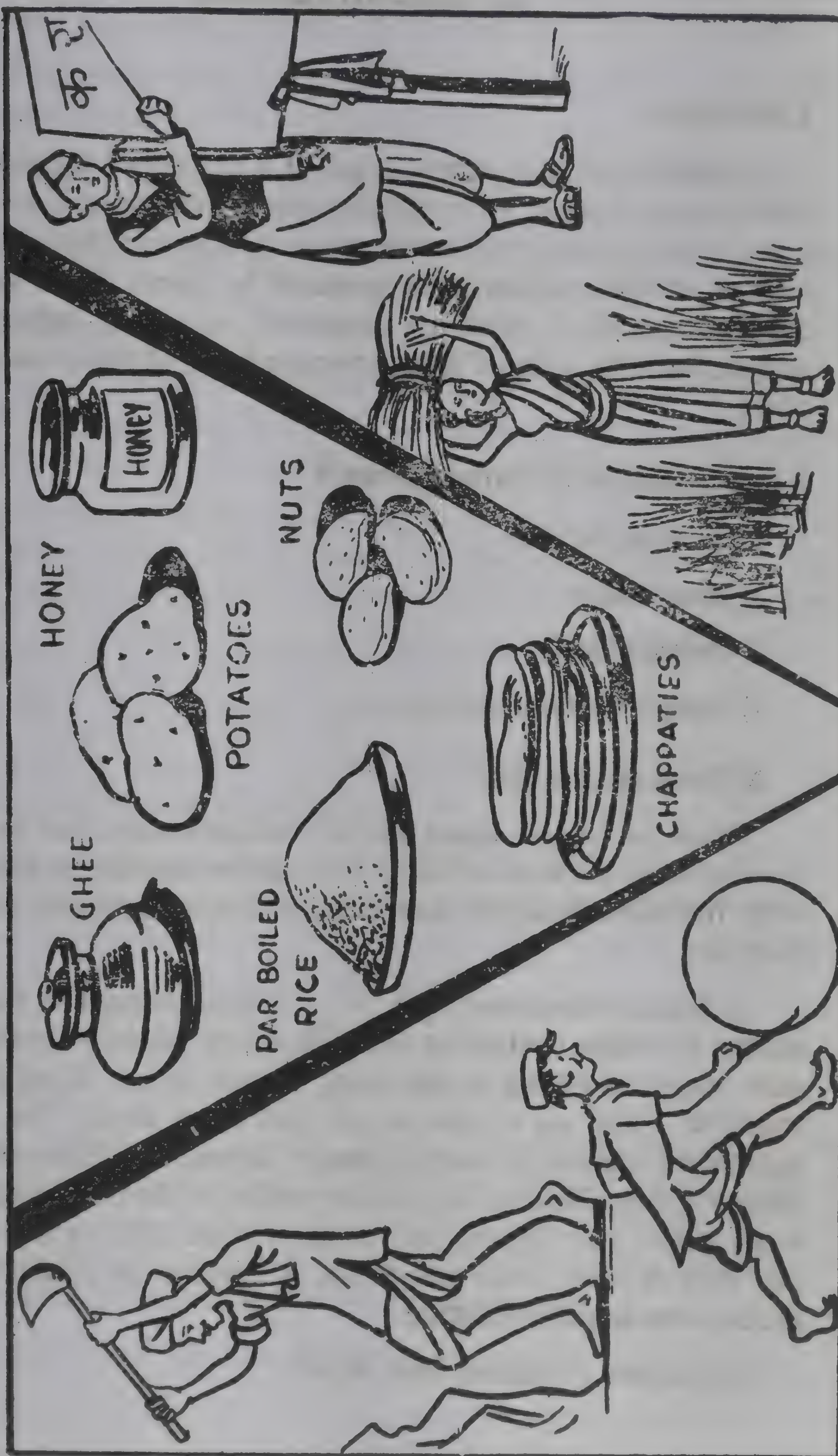
1 gm. of carbohydrates gives	4 Calories (Cal.)
1 gm. of Protein gives	4 Calories (Cal.)
1 gm. of fat gives	9 Calories (Cal.)

Thus if the carbohydrate, fat and protein content of foods are known, the Calorie value can be figured:

e.g., Rice (raw)

Carbohydrate content of	79 gm. per 100 gm. gives	316 Cal.
Fat content of	0.4 gm. per 100 gm. gives	4 Cal.
Protein content of	6.4 gm. per 100 gm. gives	26 Cal.
Total Cal.	**per 100 gm. (approx.)**	**346 Cal.**

Food tables have been constructed showing the contents of various nutrients in food and the Calorie Value. The book *The Nutritive Value of Indian Foods* by the National Institute of Nutrition, Indian council of Medical Research Hyderabad, India should be consulted. This gives food values for 100 gm. portions.



FOODS FOR ENERGY

I. Carbohydrates

1.Definition

A carbohydrate is a simple sugar or a compound formed by the combination of two or more simple sugars. Carbohydrates are formed from carbondioxide from the atmosphere by photosynthesis in plants. Animals eat the carbohydrates prepared by plants. There are many carbohydrates all of which are compounds of carbon, hydrogen and oxygen. But only a few of these compounds are of importance to our study.

2.Classification of Carbohydrates

1) Monosaccharides
2) Disaccharide
3) Polysaccharides
4) Complex polysaccharides.

A) Monosaccharides

These are simple sugars and all carbohydrates must be broken down to monosaccharides before they can be absorbed in the human body. The following are the most important monosaccharides in human nutrition:

(i) Glucose (Dextrose) $C_6H_{12}O_6$. Glucose belongs to the group aldoses or sugars containing aldehyde group. Glucose serves as the main source of energy in the body. Normal human blood contains about 80 - 120 mg of glucose per 100 ml of blood. This level is maintained constant in healthy people. In persons suffering from the disease Diabetes Mellitus the glucose content of the blood increases to levels higher than 180 mg per 100 ml of blood. Glucose is present in free state in many fruits and honey. It contains an aldehyde group and reduces Benedict solution.

(ii)Fructose (Levulose, fruit sugar)

Fructose occurs in the free state along with glucose in many fruits and honey. It is readily utilised by the body as a source of energy.

(iii) Galactose does not occur in the free state. It is a constituent of lactose present in milk.

(iv) Ribose present in ribonucleic acid (RNA) and deoxyribose a constituent of deoxyribonucleic acid (DNA) are two other monosacchardies. These are present in both plants and animal tissues.

B) Disaccharides

These are formed by the combination of two monosacchardies by the elimination of one molecule of water. Nutritionally important disacchardies are (i) Sucrose (ii) Maltose (iii) Lactose.

(i) Sucrose (Cane sugar, beet sugar). It is manufactured on a large scale from sugar cane or beet root. Sucrose is formed by the condensation of one molecule of glucose and one molecule of fructose.

Sucrose + H_2O + **Fructose** – Dilute HCL Glucose

Sucrose + H_2O **Sucrose** Glucose + Fructose

(ii)Maltose (Malt Sugar). It is formed by the condensation of two molecules of glucose by the elimination of one molecule of water.

Maltose is formed from starch during the germination of cereal grains (barley, ragi etc) and digestion of starch by enzyme amylase . Maltose is hydrolysed into two molecules of glucose by the enzyme maltase present in the intestinal juice.

Starch **Amylase** Maltose

Maltose + H_2O **Maltase** Glucose (two molecules)

(iii) Lactose (Milk sugar). Lactose is present in the milk of all mammals. Lactose is formed by the condensation of one molecule of glucose and one molecule of galactose with elimination of one molecule of water. Lactose is hydrolysed to glucose and galactose by the enzyme lactase present in the intestinal juice.

Lactose + H_2O **Lactase** Glucose + Galactose.

The disaccharides are crystalline substance soluble in water but they must be broken down to their constituent monosaccharides to be absorbed in the body.

C) Polysaccharides

These are made up of many units of monosaccharides . The majority are insoluble or only slightly soluble in water. Some of the nutritionally important polysaccharides are:

(i) Starches form the reserve food stored in plants. They may be laid down in seeds such as cereals and dhals (pulses) in stems such as plantain stem, and in roots and tubers such as potato, yam and tapioca. Unripe fruits contain starch, which is converted into sugar during the process of ripening.

Starch is a polysaccharide made up of a large number of glucose molecules. It consists of a mixture of two components called amylose and amylopectin. One molecule of amylose contains 500 to 5000 glucose molecules and one molecule of amylopectin contains 50,000 to 500,000 glucose molecules. Starch is a white tasteless powder insoluble in cold water. When starch is boiled with water it forms a paste. Cereal starches differ from root and tuber starches in their physical properties due to the differences in the chemical nature of amylose and amylopectin present in them. Glucose is manufactured by the hydrolysis of starch.

(ii) Glycogen is reserved carbohydrate found in liver (3 to 7%) and muscles (.5 to 1%) of animals and man. It is sometimes called animal starch. It must be converted back into glucose to be used in the body.

Glycogen is formed by the condensation of large number (5000 to 10000) of glucose molecules.

(iii) Dextrins are a group of substances formed during the breakdown of starch to maltose during the process of digestion in the human body, or in the germination of seeds, or in some of the processes used in cooking. The golden brown colour produced in starchy foods during baking and frying is due partly to dextrine. Dextrines have a faintly sweet taste and form sticky solutions in water. These solutions can be used as gum. E.g., on postage stamps.

(iv) Cellulose is a polysaccharide made up of glucose. It is not acted upon by the enzyme amylase. A very stable insoluble compound, cellulose is the main constituent of the cell walls and supporting tissues in plants. It forms a large part of the plant foods used in nutrition, e.g., cereals, dhals, fruit, vegetables. Cellulose does not give any calorific value in the diet of human beings because it is not broken down by digestive processes in the human body. There may be some bacterial action on cellulose in the large intestine but this does not contribute anything of much value to the body. The main value of cellulose is in adding bulk or roughage to the diet and thus stimulating peristalsis in the intestine. It is important to realise that the cell walls of plant foods must be broken, either by adequate cooking or chewing or grinding in order that the nutrients contained in the cells should be released for digestion in the gastro intestinal tract.

(v) Galactans are polysaccharides composed of galactose molecules. They occur in large amounts in sea weeds. Agar-Agar, which is used in culture media for growing bacteria, belongs to this group.

Other polysaccharides such as fructosans and pectins are used in various other ways.

3. Digestion and Absorption

Reference should be made to the section on digestion in an anatomy and physiology book for details of the digestion of carbohydrates. The processes may be summarised as follows.

Ptyalin present in the saliva converts cooked starch into maltose. Pancreatic amylase also acts upon starch, converting it to maltose, the action being much stronger than that of ptyalin. Sucrose, lactase and maltase present in the intestinal juices act respectively on the disaccharides -- sucrose, lactose and maltose, breaking them down to the monosaccharides of which they are composed. These are absorbed in the intestines.

4. Effects of Cooking

Reference should be made to the section on cookery for the effects of cooking on carbohydrate foods.

5. Functions of Carbohydrates

(i) Carbohydrates form the chief and most readily available source of heat and energy in the animal body. Each gram supplies 4 calories. Carbohydrates supply 50 percent or more of the total daily requirement of calories for human beings. In ordinary diets about 10% of total calories are supplied by proteins and 20 – 25% by fat and the remaining 65 – 75% in the form of carbohydrates. Carbohydrates foods are also among the cheapest foods available. Glucose is often given to sick people and invalids to provide energy easily.

(ii) They are essential for the oxidation of fats.

Carbohydrates prevent the excessive breakdown of fats and the development of ketosis. Normally, fatty acids from fats are broken down to ketone bodies in the liver. To completely oxidize them to the final stage of carbon dioxide and water, carbohydrate is necessary. If there is not enough carbohydrate available incompletely oxidized ketone bodies will collect in the blood, resulting in ketosis.

(iii) Carbohydrates also prevent excessive breakdown of protein. When there is no carbohydrate available, protein is used as a source of energy and is then not available for its specific functions of building and repairing tissues.

(iv) Carbohydrate in the form of cellulose provides roughage in the diet and thus aids elimination of waste material from the intestines.

(iv) They provide the carbon skeleton for the synthesis of some non-essential amino acids.

(v) Some carbohydrates are tissue constituents.

(vi) They add flavour to the diet.

(vii) Carbohydrates in the form of glucose are essential for the function of nervous tissue. It is also essential for the functioning of heart and liver

6. Sources of Carbohydrates

As may be seen from the classification of carbohydrates, the chief sources of this nutrient in foods are the sugars and starches. Glucose

is a sugar now in common use medicinally but the other monosaccharides are not used to any great extent although glucose and fructose are found in fruits. Cane sugar and jaggery (gur) are disaccharide sugars in common use in India. All sugars are 100% carbohydrates and give a calorie value of 300-420 Cal. Per 100 gm. Fruits contain a lot of water, some sugar, but very little protein or fat. A medium sized fruit, except for plantains and dried fruits which have a higher calorific value, gives approximately 40 Cal..

Starch is present in cereals, dhals(pulses) and in roots and tubers. All the common cereals contain about 75% of starch along with some protein but very little fat, and give approximately 350 cal per 100 gm. of dry cereal. The different kinds of dhals and grams have approximately the same composition, containing less carbohydrate than cereals, but more protein, and supply approximately 330 cal. per 100 gm.

All vegetables contain some carbohydrate but cannot be called good sources because of the large percentage of water present in them.

Nuts contain some carbohydrate, protein and fat, but the quantity of nuts eaten per day is very small compared with that of cereals and pulses and therefore they are not such good sources.

7. Carbohydrate requirements

The body has a specific need for carbohydrates as a source of energy for the brain and other tissues cells and for the synthesis of lactose of milk. Carbohydrate is essential for oxidation of fat, and for the synthesis of certain non-essential amino acids.

II. FATS

FATS AND OILS

Fats and oils belong to a group of substances called 'lipids'. These substances are characterised by their insolubility in water and greasy feel. They occur in the plant and animal kingdoms. Oils are liquids at 20°C while fats are solids at 20°C. Besides fats and oils other important lipids include sterols, fatty acids and phospholipids.

1.. FATTY ACIDS

The fatty acids or mixture of fatty acids give each fat its characteristic flavour, odour and appearance. Fats and oils are esters of fatty acids with glycerol. They are triglycerides. Fatty acids are divided into two.

(i) Saturated Fatty Acids: Since they have no double bonds (unsaturated linkages) they cannot be altered by hydrogenation. Sources of saturated fatty acids are butter, coconut oil, and animal fat.

(ii)Unsaturated Fatty Acids: The unsaturated Fatty Acids contain one or more double bonds and so can take on more hydrogen under varying conditions; they are referred to as monounsaturated or polyunsaturated. All the common unsaturated fatty acids are liquids at room temperature. Sources are vegetable oils such as corn oil and soyabean oil. They contain triglycerides. In general, vegetable oils are rich in unsaturated fatty acids whereas animal fats are rich in saturated fatty acids, coconut oil and oils of fish and whale liver being the exceptions.

2. ESSENTIAL FATTY ACIDS

The three polyunsaturated fatty acids, linoleum, linolenic and arachidonic are known as essential fatty acids because:

(i) They cannot be synthesized in the body and so must be supplied in the diet.

(ii)They are necessary for proper growth and metabolism. Prolonged dietary lack of essential fatty acids has resulted in eczema and other skin conditions in children. Fortunately the essential fatty acids are found in abundance. Eggs and vegetable oils such as cottonseed oil, sunflower seed oil and sesame or gingerly oil are good sources.

3. STEROLS

Sterols are organic compounds found in plant and animal tissues. They occur in the free state and as esters with fatty acids. Sterols are classified as follows:

(i) Animal sterols e.g. Cholesterol.

(ii)Plant sterols e.g. phytosterol and

(iii) Micosterols e.g. ergosterol.

Cholesterol is a normal constituent of the tissues but is especially important in the formation of brain and nervous tissues. It serves as a processor of vitamin D; that is cholesterol in the skin can be changed into active vitamin D by exposing to ultraviolet rays in sunlight. Cholesterol is closely related to the sex hormones and to the hormones of the adrenal gland. Excess of cholesterol is removed from the body in the bile. The body can manufacture cholesterol from fats, carbohydrates and amino acids.

4. *PHOSPHOLIPIDS*

These are fats in which a phosphorus nitrogen compound has been substituted for one of the fatty acids in the triglyceride molecule. Phospholipids are important in brain and nervous tissue. They also assist in the absorption of fats from the small intestine and in the transport of fats in the blood.

5. *LIPOPROTEINS*

By being attached to proteins fats can be held in solution in the blood circulation and carried to the tissues. The lipoproteins are synthesized in the liver. They contain varying amounts of triglycerides, cholesterol, protein and phospholipids.

6. *PROPERTIES OR CHARACTERISTICS OF FATS*

(i) They are insoluble in water, but soluble in fat solvents such as ether, chloroform, alcohol, and carbon tetrachloride. In blood circulation they are held insoluble by being attached to proteins (lipoproteins).

(ii)Fats are tasteless and odourless except for a slight taste characteristic of some fat. After long exposure to air, fats may become yellow in colour with a rancid or spoilt taste.

(iii) Neutral fats or triglycerides are broken down to fatty acids and glycerol on digestion.

(iv) The elements in fats are Oxygen, Hydrogen and Carbon just as, in carbohydrates but the ratio is different. The fats contain much less oxygen and much greater proportion of carbon and hydrogen and hence they have more fuel value.

7. DIGESTION

The digestion of fats is brought about by the action of lipase, enzyme present in the pancreatic and intestinal juices, together with the action of bile, which helps in emulsification.

8. FUNCTION OF FATS

(i) Fat is an important source of energy, giving 9 Calories per gram, more than twice the Calorie value of carbohydrates and protein. All kinds of fat have the same Calorie value, and when included in the diet can add Calories without greatly increasing the bulk of the diet. It is important to note, however, that the quantity of fat, which can be eaten in one day, is limited, and therefore the proportion of Calories from fat is not usually greater than the proportion of Calories from carbohydrate.

(ii) Fat usually delays the digestion of food in the stomach possibly because it depresses the secretion of gastric juice. In some persons this may be a disadvantages, but for the normal individual it is an advantage because it delays the emptying of the stomach and the beginning of the feeling of hunger. This is known as the satiety (satisfying) value of fat.

(iii) Fats are essential for the absorption of vitamins A,D,E,K and especially carotenoids (Provitamin A) present in foods of vegetable origin.

(iv) Some animal fats e.g. fish liver oils, butter and ghee contain vitamin A and many vegetable fats contain vitamin E. Red palm oil is a good source of carotene (provitamin A).

(v) Fats contain essential fatty acids namely linoleic, linolenic and arachidonic acids, which are essential for maintaining tissues in normal health especially the skin.

(vi) Fats improve the palatability of the diet.

(vii) Fats are essential for the utilization of galactose present in lactose.

(viii) Fat is the most compact form of food stored in the animal body. Excess carbohydrate in the diet is converted to fat and is stored. These stores act as padding for blood vessels, organs, angular corners of the body, and in protecting against heat loss. This deposit serves as a reserve source during starvation.

9. SOURCES OF FAT

Most fats and oils used in preparation of food e.g., groundnut oil; gingelly oil and coconut oil are 100 percent fat and therefore give about 900 Calories per 100 gm.

Foods of animal origin, e.g., meat, fish, milk, butter, cheese and eggs, and fish liver oils contain varying amounts of fats which contribute to the calorie value of food. Foods of plant origin with the exception of nuts contain very little fat .

	%Fat	Cal. per 100gm.
Groundnut	40.1	549
Coconut	41.6	444
Cashewnut	46.9	596
Walnut	64.5	687

The Cellulose present in nuts must be broken down by thorough cooking, grinding or chewing if the whole of the fat and calorie value is to be made available to the body.

10. FAT REQUIREMENTS

The quality of fat that should be included in a well balanced diet is not known with certainty. It appears desirable that the daily intake

of fat should be such that it contributes not more than 15 to 20 percent of the calories in the diet. A total of 40 to 60 grams of fat may be consumed daily and in order to obtain the necessary amounts of essential fatty acids, the fat intake should include at least 15 gm of vegetable oils.

11. CLINICAL PROBLEMS

(i) Obesity is a problem since fats are concentrated sources of energy.

(ii)Diets rich in saturated fats/sugar and/or cholesterol lead to increase serum cholesterol levels. The elevation of serum cholesterol is associated with increased incidence of coronary heart and blood vessel diseases due to atherosclerosis.

(iii) Diets rich in fat or carbohydrates may lead to hyperlipidemia. In this condition only serum tryglycerides are increased. The treatment is a low fat diet.

QUESTIONS FOR STUDY

1) Which nutrients supply energy and how much does each give per gram?
2) Keep a record of everything you eat in a day and figure out how much carbohydrate and fat and how many Calories this supplies. How does this compare with your energy require ments according to the table on page 92?
3) Which of the foods you listed in question 2 is largely carbohydrate? What different kinds of carbohydrates are included? Which of these foods give fat?
4) What are the important differences between the three classes of carbohydrates?
5) What is the form of carbohydrates circulating in the blood? Found in rice? Found in milk? Found in sugar cane? Found in fried palaharams (snacks) ?

6) Describe the steps necessary before the starch in rice can be used as energy by the body?

7) Why may ketosis result when a diet is very high in fat and limited in carbohydrate?

8) If we eat more carbohydrate and fat than are necessary for energy what happens to the excess?

9) Carbohydrates and true fats both contain carbon, hydrogen and oxygen. How are they different?

10) Fats usually have little taste. When may they develop a distinct taste?

11) If you spill some greasy food on your clothes why can you not wash it out with plain water?

12) What part of all Calories needed for energy is normally provided by fat and what part by carbohydrates?

13) What do you mean by the satiety value of fat?

14) What effect will the presence of fatty foods like fried meat or sauce, containing oil, have on the digestion of the whole meal?

15) Name four animal and four vegetable sources of fat.

16) What is the fat content in grams of:

    1 cup of milk (200 gm)

    30 gm. of ghee

    30 gm. of groundnuts

17) A diet contains 70 gm of protein, 125 gm of fat and 250 gm of carbohydrate ---

    What is the relation of Calories obtained from fat and from carbohydrate in this diet?

    What percent of the total Calories in this diet come from fat?

CHAPTER 4

FOODS FOR GROWTH AND REPAIR OF THE BODY

I PROTEIN

1. PROTEIN

The second of the main functions of food is to supply materials for growth and repair of the body. When a baby is born it is small and helpless, but during the first year of life it grows and gains strength so that it is able to lift its head, then sit up, stand and walk. Growth continues until the age of 20-25 years, and throughout life the tissues of the body are continually in need of repair as they wear out or are injured. For growth and repair many nutrients are needed, chiefly proteins and minerals. Protein forms the basic structure of all cells of the body and the mineral or inorganic elements are often associated with protein for special function,

E.g. Calcium and phosphorus in bone

Iron in haemoglobin in blood.

There are other inorganic elements whose function is associated more with the protection of the body and regulation of body processes.

Definition

Proteins are the main organic constituents of the animal body. They form the basis of the muscular tissue of the body, the protective structure such as bones, cartilage, skin, hair and nails and provide a large part of the total solids of the body.

1. Structure of Proteins

Proteins are very complex substances formed by the combination of amino acids. They contain carbon, hydrogen, oxygen and nitrogen. Some contain also sulphur and phosphorus, or may be combined with non-protein substances. There may be 250 or more amino acids in

any one protein, and these may be of about 20 different kinds. Proteins differ according to the types of amino acids present.

Plants can manufacture protein from the inorganic substances present in soil, air and water. Animals cannot do this, but can use plant proteins for food and for the construction of their own body proteins.

2. Digestion of Protein

There are several enzymes responsible for the breakdown of proteins into the amino acids of which they are composed. Rennin causes the coagulation of the casein in milk. Pepsin, in the presence of hydrochloric acid in the stomach, changes proteins to proteoses and peptones. These are further broken down to amino acid by trypsin of the pancreatic juice, and erepsin of the success entericus. The amino acids thus produced are absorbed into the blood stream and taken to the liver where they are built into proteins which the body needs, or broken down for the production of energy, giving the waste product urea.

There are some 22 Amino Acids, which are called essential amino acids, because the body cannot synthesise them in sufficient quantity. Hence they must be supplied by the dietary proteins.

These are: Leucine, Iso leucine, Lysine, Meuionine, phenylalanine, Threonine, Tryptophan and Valine. Infants require in addition to these, histidine for growth. In some foods such as milk and egg, the proteins have a pattern of amino acids considered most suitable for humans.

The proteins may be classified into:

(i) Complete or first class proteins. These contain all the essential amino acids in sufficient quantity for the needs of the body. The amino acids are in approximately the same average proportions of those found in the chief tissue proteins of the human body. The first class proteins are mainly from animal sources, e.g., milk, cheese, meat, fish, and eggs.

Soya beans and nuts are the only plant foods containing first class

proteins, and nuts must be thoroughly ground or cooked for the nutrients to be available.

(ii) Incomplete or Second class proteins are proteins in which either some of the essential amino acids are lacking, or there is a large proportion of one or more amino acids which are required only in a small amount. Some of the second class proteins are adequate for maintenance of the body but not for growth; others are inadequate for both. Second class proteins are obtained mostly from plant sources, cereals and pulses (dhal). Gelatine, obtained from bones and cartilage in the one animal protein which is inadequate for growth and maintenance.

3. Biological value of proteins

Since some proteins are adequate for the needs of the body and others are inadequate, it follows that proteins differ in value. The extent to which food protein can be used to replace tissue protein is known as the biological value of protein. The biological value of first class protein is high, and that of second class protein is lower. When plant proteins such as cereals, wheat, rice which are poor in the amino acid lysine are combined with pulses (dhal) which are poor in methionine but rich in lysine, there is a mutual supplementary effect and the mixed vegetable protein has an improved biological value.

4. Properties of Protein

The properties of protein are many and varied but only those of specific interest in nutrition need be considered.

(i) Some proteins are soluble in water, e.g., egg albumin, used in the preparation of albumin water. When heated, however, egg albumin coagulates and is not then soluble in water. Gelatin is soluble in water and sets to a gel on cooling if sufficiently concentrated.

(ii) Most proteins are not soluble in water but are soluble in dilute salt solutions such as are found in blood and tissue fluids. The transport or carrying of proteins in solution in the body is made possible by this property.

(iii) When protein is strongly heated it becomes changed. This

change is mainly hardening. E.g., coagulation of egg albumin and meat protein on cooking.

5. Functions of Protein

(i) Protein is necessary for growth and repair of the body. During childhood and adolescence the body is continually growing and tissues wear out and have to be replaced. Even in the adult body, tissue replacement or maintenance continues, as seen by growth of hair, and finger and toenails, healing of wounds and restoration of wasted tissues during and after disease.

(ii) Protein is a necessary constituent of normal secretions of the body, eg., enzymes and hormones, and for antibodies and haemoglobin.

(iii) Protein is essential for maintaining the correct osmotic pressure of blood. Hypoproteinaemia, or deficiency of protein in the blood, which upsets the osmotic pressure of the blood, is one cause of oedema.

(iv) Protein has a stimulating effect upon metabolism known as the specific dynamic action of protein.

(v) Protein may be used as a source of energy, but since it has more important functions, as given above, the greater part of the daily requirement of Calories should come from carbohydrate and fat, and not from protein.

6. Requirements of Protein

The I.C.M.R. recommends 1 gm. of protein/K.G. of body weight for adults (45 to 55 gms/day). The amount of protein should be increased for pregnant and lactating mothers by 14 to 25 gms/day. It should be noted that growing children and adolescents need a higher proportion of protein for their body weights than adults. (See table on page 98). It would be desirable to provide children with diets, which are adequate in calories and provide 8 to 10% of total calories as protein calories.

7. Sources of Protein

The main sources of protein are:

1st class protein	***gm. per 100 gm.***
Milk (cow's)	3.3
Curds	2.9
Mutton	18.5
Bee	22.6
Liver	19.3
Fish	22.6
Egg (hen's)	13.3
Groundnuts	26.7
Soya	43.2
2nd class protein	
Wheat	11.8
Ragi	7.1
Rice (parboiled)	6.4
Red gram dhal	22.3
Bengal gram	22.6

There are two important points to remember when selecting food for its protein content:

(i) The amount of the food that can be taken daily.

(ii) The effect of cooking.

Milk contains only 3.3 gm. protein per 100 gm. but a large quantity can be taken daily and thus provides a good source of protein.

Dhal, when cooked, absorbs twice its weight of water. Also, the maximum amount of dhal which can be taken in one day is not much, so there is a limit to the amount of protein available.

In vegetarian diets where milk is the only source of animal protein, sufficient quantity of milk should be included in the diet to give the required amount of first class protein. In all diets it is advisable to have some first class protein and some second class protein in all meals as the biological value of a mixture of proteins is higher than that of the individual proteins. It is not desirable to have all the protein given as animal protein because of its harmful effects on the body. Also animal protein is beyond the means of large majority of people in India. Diets, which provide 8-10% of total calories in the form of protein, are likely to be adequate both in protein and calories if the protein is derived from different sources such as cereals, pulses, leafy vegetables and milk.

Present day nutritionists are concerned with making the quantity and quality of plant proteins adequate for human nutrition. Attempts are also being made to utilize proteins from novel sources such as yeast, green leaves and algae, and to improve the quality of cereal-proteins by fortifying them with lysine.

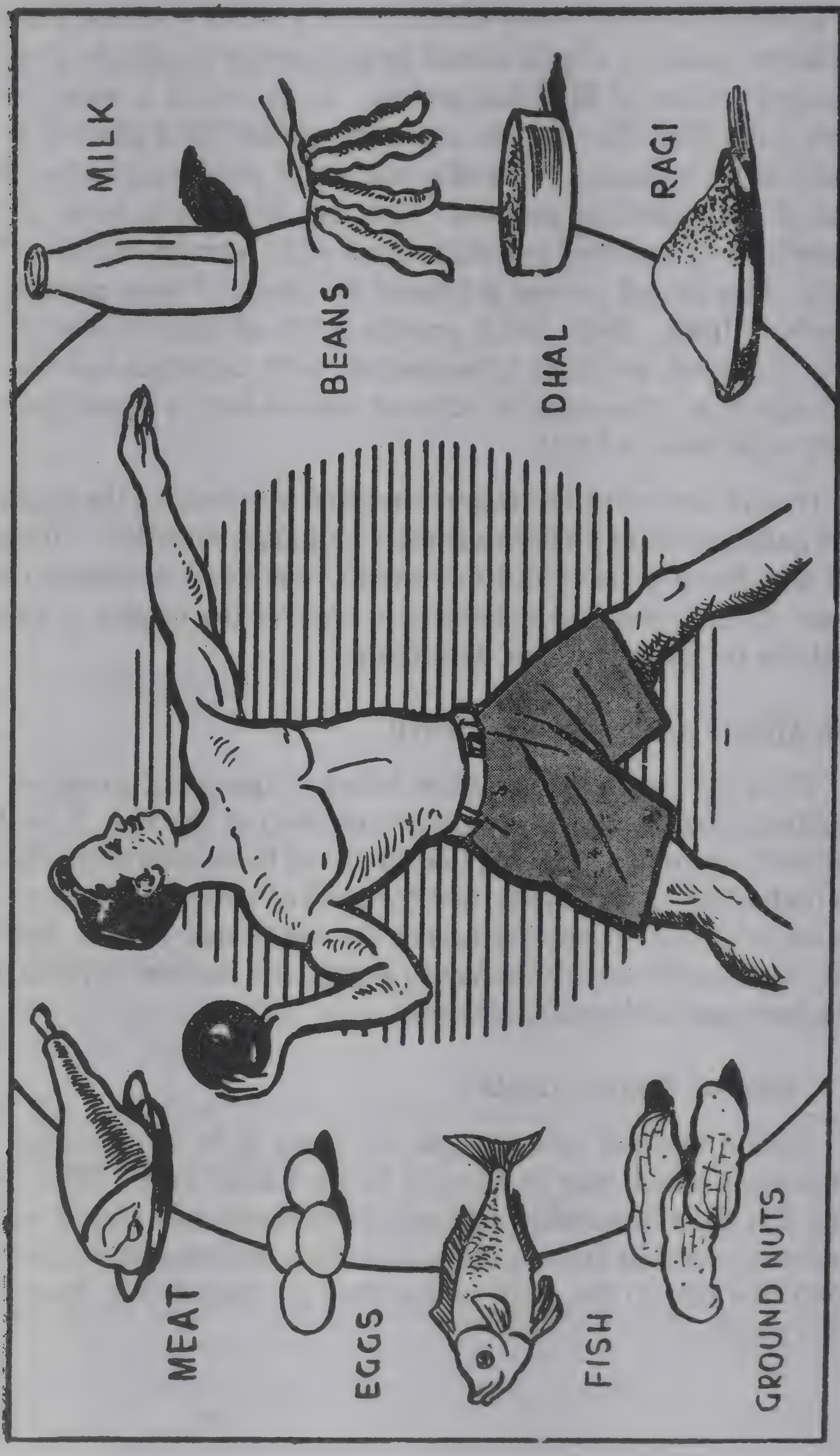
10. Effects of Protein deficiency

When the protein intake is low during the period of growth ie., in childhood and adolescence, growth is retarded or checked. If the low intake is continued for a long time there will be wasting of the tissues in both children and adults, and the level of serum protein may fall so low as to cause hypoproteinaemia and nutritional oedema. Protein may therefore be regarded as having a protective function in protecting the body against hypoproteinaemia.

11. Care of Protein foods

Protein foods of animal origin are likely to be contaminated by organisms, which may be harmful to the human body. Milk, meat and fish must be handled with strict cleanliness and should not be exposed to dust or flies. In the tropics, flesh foods should not be kept from one day to the next unless they are placed in a freezer or refrigerator.

BODY AND MUSCLE BUILDERS



Eggs may be tested for freshness by placing them in a bowl of water. A fresh egg will lie at the bottom. If stale, one end of the egg will rise, and if bad the egg will float.

Milk should always be boiled as soon as it is received and should then be cooled by putting the vessel to stand in cold water. It must be covered and if possible, kept in a refrigerator.

Cheese does not keep well except in a refrigerator. However it will keep at room temperature for some time if covered tightly with wax paper.

QUESTIONS FOR STUDY

1) What is the chief difference between the structure of proteins and carbohydrates?

2) Why are some amino acids called essential?

3) Review the digestion of proteins in your anatomy and physiology book.

4) Why is it difficult to provide adequate protein in a vegetarian diet?

5) What is the difference in solubility of raw and cooked egg albumin?

6) Why does a patient with an injury like a burn or large wound require more than normal amount of protein?

7) What kind of growth requires protein continuosly even in old age? For what other purpose does an old person need protein?

8) Name two circumstances when more than normal adult allowances of protein will be needed? (See table on page 98).

9) What is the effect of protein on metabolism?

10) What will be the result of lack of sufficient protein in the diet of a ten-year-old girl? Of an adult?

11) Keep a record of all you eat in an average day. How much protein is included? What fraction of your total protein intake is of complete or first class proteins?

12) Plan a vegetarian diet for yourself, which will include adequate amounts of complete proteins.

13) One cup of milk contains 7 gm. of protein. How much of each of the following foods would be necessary to provide an equal amount of protein: dhal, mutton, egg, skimmed milk powder, ragi, rice, wheat?

    About how much would each cost? What does this show you?

II. MINERAL OR INORGANIC ELEMENTS

Carbohydrates, fats and protein already studied are organic compounds, but in the human body there are also substances, which are usually studied by the inorganic chemists. These are sometimes called mineral salts or inorganic elements but neither term is adequate because most of the inorganic substances are combined with organic compounds in the body. Four chemical elements make up about 96 percent of the body weight. They are elements make up about 96 percent of the body weight. They are:

Oxygen 65%	Hydrogen 10%
Carbon 18%	Nitrogen 3%

The remaining 4 percent are made up of minerals. Some of these are present in very small amounts. The approximate elementary composition of the human body has been given by Sherman:

Element	Percentage	Element	Percentage
Oxygen	65	Sodium	0.15
Carbon	18	Magnesium	0.05
Hydrogen	10	Iron	0.004
Nitrogen	3	Manganese	0.0003
Calcium	2.2	Copper	0.00015
Phosphorus	1.2	Iodine	0.00004
Potassium	0.35	Cobalt	Trace
Sulphur	0.15	Zinc	Trace
Chlorine	0.15		

GENERAL FUNCTIONS OF ELEMENTS

Many of the inorganic elements assist in the growth and repair of the body and are also concerned with regulation of the body processes. Their functions therefore may be in one or more of three ways.

(i) As constituents of hard tissue.

E.g. calcium and phosphorus in bones and teeth.

(ii) As constituents of soft tissue.

E.g. sulphur and phosphorus in many tissue proteins

Iron in haemoglobin

Iodine in the hormone thyroxine.

Zinc associated with the hormone insulin.

(iii) As constituents of substances concerned in regulatory functions in the body.

E.g. salts in solution influence nerves and muscles, help to dissolve proteins insoluble in water and assist in the maintenance of osmotic pressure.

Eg. Inorganic elements supply material for the acidity and alkalinity of the digestive juices, and for helping to maintain the normal reaction of the body.

The first two of these functions indicate that inorganic elements are necessary for the composition of hard and soft tissues and thus are essential for the growth and repair of the body. This has already been given as one of the main functions of food. Inorganic elements are also needed for regulation of various processes in the body. This is another main function and the role of inorganic elements should be borne in mind together with the functions of vitamins, which will be considered in a later section.

A. CALCIUM AND PHOSPHORUS

After carbon, hydrogen, oxygen and nitrogen, calcium and phosphorus are the inorganic elements found in largest proportion in the human body. These two elements are mostly found together in bones and teeth and therefore will be considered together.

1. Functions

(1) As constituents of hard tissue

99 percent of the total body calcium and 90 percent of the total

body phosphorus are found in bones and teeth.

Calcium and phosphorus are therefore necessary for growth and maintenance of bones and teeth, in addition to protein, which is necessary for the matrix.

(ii) As constituents of soft tissue

Calcium is present in blood. It is also present in other fluids of the body, e.g. cerebrospinal fluid and in the milk, which is secreted by the mammary glands.

Phosphorus is present in the proteins of many cells and may also be associated with fat.

(iii) As constituents of substances concerned with regulatory functions Calcium is necessary for

(a) The correct functioning of nerves and muscles.

(b) Clotting of blood.

Prothrombin, present in normal plasma, is converted into thrombin by the action of the enzyme thrombokinase, which is released in damaged tissues. For this action to take place quickly, calcium ions are necessary. Thrombin thus formed acts upon the fibrinogen, also present in normal plasma, causing the formation of insoluble fibrinogen, also present in normal plasma, causing the formation of insoluble fibrin necessary for the clot. The action of thrombokinase is very slow in the absence of calcium.

Phosphorus also has regulatory functions.

(a) Compounds containing phosphorus help to keep constant the reaction of the blood.

(b) Phosphorus compounds are necessary for carbohydrate metabolism and in the calcification of bone.

2. *Absorption*

The absorption of calcium from the intestine is never complete; approximately 30 percent of the calcium present in food is absorbed,

the remainder being eliminated in the faeces.

Factors, which may hinder the absorption of calcium, are:

(i) Too much phosphorus in the form of phosphate in food.

(ii) Anything which causes food to pass quickly through the intestine,

E.g. infections that cause diarrhoea, purgatives or too much roughage in food.

(iii) Any substances which forms an insoluble salt with calcium.

E.g. excess fatty acids, oxalates present in green plantain, spinach and cashewnuts, phytin a compound containing calcium and magnesium and found mainly in the bran of cereals.

(iv) Deficiency of Vitamin D may influence absorption of calcium.

3. Metabolism

The metabolism of calcium is concerned mainly with the calcification of bone. Vitamin D is considered essential for the deposition of calcium and phosphate.

If the calcium intake is adequate and without excess phosphorus, calcification of bones is good but if the calcium intake is inadequate or there is excess phosphorus, the bones do not harden properly and cannot bear the weight of the body. This leads to rickets in children and adolescents which when severe will be shown by knock-knees or bow legs, pigeon-chest and other bone deformities. In adults osteomalacia or softening of the bones may result, with deformities especially in the pelvis.

If calcium is taken in excess of requirement it does not have an unfavourable effect on the body, but can be stored in the long bones and used at any time when the calcium intake may be inadequate.

The calcium content of the bones is constantly changing as calcium in food is used to replace bone calcium, and over a period of several months, the total calcium content of the body may be completely

renewed.

4. *Requirements*

The constant renewal of calcium, even in the adult body, means that there must be a daily requirement of calcium throughout life. The requirements are given on page 98, and it should be noted that growing children and adolescents and pregnant and nursing mothers need more than adult men and women.

RECOMMENDED INTAKE OF CALCIUM

(1.C.M.R. 1981)

Age Group	(Mg/Day)
Adult	
Man & Woman	400 – 500
Pregnancy and lactation	1000
Infants	500 – 600
Children (years)	
*1 to 9	400 – 500
10 to 15	600- 700
16 to 19	500 - 600

*Applies to artificially fed infants. Breast fed infants needs no additional supplement. Source: Park JE (1998).

5. *Sources*

There is more phosphorus than calcium in all the commonly used cereals except ragi and pulses (dhals) so that Indian diets, particularly strict vegetarian diets, usually contain more phosphorus than calcium, and this excess phosphorus may prevent absorption of calcium and cause calcium deficiency. The phosphorus content of diets can be calculated using food tables, but it is much more important to see that the calcium content is adequate. It has been said that if you look after the calcium content of a diet the phosphorus content will look

after itself.

Reference should be made to food tables for details of the calcium content of food, but the following main sources should be noted.

Milk is one of the best sources of calcium for the human body, and it is an important item to include in daily food because it also contains first class protein and some of the vitamins.

Green leafy vegetables especially amaranth leaves and drum-stick leaves contain calcium, and these are important additions to the daily food, especially for poor people who may not be able to afford to buy enough milk.

Ragi has the best calcium content of the commonly available cereals, but rice is a very poor source of calcium. It is therefore advisable that a rice diet should be supplemented with ragi. Wheat may also be used.

Mutton has the highest calcium content of the flesh foods with the exception of crab muscle, which is not commonly eaten.

Other vegetables vary in calcium content, but beetroot, onion, ladies fingers (okhra) and carrots will add to the total calcium intake if used regularly.

6. Factors limiting the use of Calcium

Purgatives, oxalates, excess phosphorus or fatty acids, phytin and deficiency of Vitamin D are substances which seem to hinder the absorption of calcium and thus affect the use of calcium. Vitamin D deficiency probably limits also the deposition of calcium in bone in the process of calcification. Calcium metabolism is also upset by deficiency of the parathyroid hormone.

QUESTIONS FOR STUDY

1) Why are minerals important in growth and repair of the body?
2) Give examples of the effect of minerals in regulating body processes.
3) In what body tissues are calcium and phosphorus found?
4) Review the process of the clotting of the blood as studied in anatomy and physiology. What part does calcium have in this process?
5) Why is it necessary to include more calcium in the daily food than the body needs to use in a day?
6) How would the fact that a patient has diarrhoea affect his requirements for calcium?
7) What is the effect on the body of a diet containing excess of phosphorus? An excess of calcium?
8) Why would pregnant and nursing mothers and children need more than the normal adult requirement of calcium? (Refer to table, page 98.)
9) What precautions must be taken in a vegetarian diet in order to provide sufficient calcium contents?
10) Plan a diet rich in calcium without the use of milk.
11) Do adults whose growth of bones and teeth has been fully reached require much calcium in their diet? Explain why?
12) How may we be certain of getting enough phosphorus in the diet?

B. IRON

The amount of iron present in the adult human body is very small, being approximately 3 gm. or less, but it is a very important substance and essential for the maintenance of life.

1. Function

Iron has no particular function as a constituent of hard tissues, its main function being as constituent of soft tissue where it has also specific regulatory functions.

(i) It is present in the nucleus of cells and is very necessary for oxidation in the tissues.

(ii) It is an essential constituent of haemoglobin and is responsible for the oxygen carrying power of the blood.

Since the oxygenation of blood is so vital to the body, iron may be considered also as necessary for one of the regulatory functions of the body.

2. Absorption

The absorption of iron from food occurs in the duodenum and upper part of the jejunum, but only a very small amount is absorbed. If a person is anaemic due to severe haemorrhage or deficiency of iron in food, extra iron can be given as medicine. The total absorption of iron may then be increased, but the treatment needs to be continued for a period of three weeks or more.

The absorption of iron may be affected by the Oxalates and Phytates in the diet as well as the quality of protein. Some animal protein and Vitamin C taken at the same meal have a beneficial effect on the absorption of iron.

3. Metabolism

The metabolism of iron is closely linked with the life cycle of red blood cells in the body, and with the condition of anaemia. Anaemia may be caused in various ways but in nutrition it is the dietary causes, which are of particular importance. The following should be noted:

Iron is a necessary constituent of haemoglobin. Deficiency of iron in the diet or failure of absorption in the small intestine may lead to anaemia.

Protein is combined with iron to form haemoglobin and is also necessary for the formation of the actual red blood cells, which are to contain the haemoglobin.

Vitamin B12 is necessary for the development of the red blood cells. It is present in foods mainly of animal origin and requires a substance present in the normal gastric juice, the intrinstic factor, for its absorption.

Folic acid has an action similar to Vitamin B12.

Other vitamins. It has been claimed that other vitamins of the B group, and ascorbic acid also have an effect on development of the red blood cells.

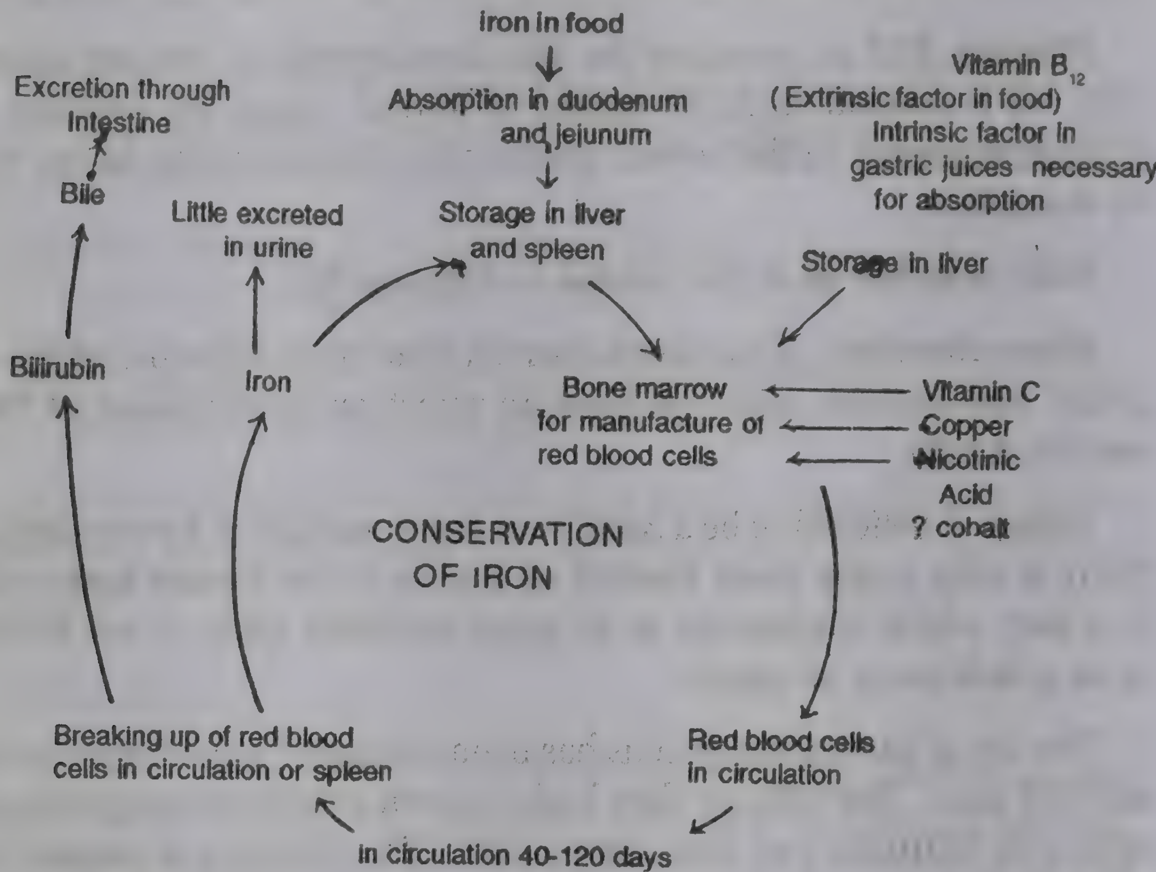
Copper is believed to be a catalyst in the formation of haemoglobin. There is only a very small amount of copper in the human body and in a diet, which is adequate in all other nutrients there, is not likely to be a deficiency of copper.

The life of the red blood cells has been estimated to be between 40 and 120 days. The cells are then broken down and the haemoglobin is split into bilirubin and iron compounds. The bilirubin is carried to the liver and excreted in the bile, while the iron compounds are stored in the liver or spleen for future use. This is known as conservation of iron in the body.

4. *Requirements*

According to the recommendation of Indian scientists, children need 15-20 mgm of iron per day and adults need 20-30 mgm in iron per day. The maximum need for children is the same as for adults, indicating or showing that during the period of growth, children and adolescents need more iron in proportion to their weight than do adults. Women have to make good the loss due to menstruation, and must also supply iron for the developing foetus when they are pregnant. For these two groups, the amount of iron stored in the body may not be sufficient, but adult men rarely become anaemic unless there is specific loss of blood through haemorrhage or infection.

Diagram illustrating the metabolism of iron



5. Sources

The requirements of iron per day may seem very small compared with other nutrients, but the amounts present in food are also small. The following sources should be noted:

Amaranth leaves	25 mg per 100 gm
Drumstick leaves	7 mg per 100 gm
Wheat	5 mg per 100 gm
Cholam	6 mg per 100 gm
Ragi	17 mg per 100 gm
Jaggery	11 mg per 100 gm
Liver	6 mg per 100 gm
Egg	2 mg per 100 gm

[1]Bilirubin--colouring material,pigments
[2]Extrinsic--from outside

It should be noted that rice, the staple food in South India, and milk, one of the foods valuable for protein and calcium content, contain very little iron.

The iron content of a diet containing mainly rice can be improved by the use of other cereals mentioned above and green leafy vegetables, particularly amaranth and drumstick leaves. Liver is valuable because it contains protein and some of the vitamins in addition to iron.

The main food for babies during the first few months of life is milk, from which they do not get much iron. Egg yolk and green leafy vegetables should therefore be amongst the first additional foods given, when mixed feeding is introduced.

6. Factors limiting use

The full use of iron in the human body is dependent on several other factors, which have been noted in the metabolism. Malnutrition generally, or deficiency of any one of the important nutrients, especially Vitamin B12 may mean that iron is not properly used.

Some scientist's claim that not all the iron content of some green leafy vegetables is available to the human body because of the oxalate content of the leaves which prevents absorption by precipitating the iron.

QUESTIONS FOR STUDY

1) What important body process does iron help to regulate?
2) How does severe haemorrhage affect the absorption of iron from food eaten?
3) What nutrients are essential in the formation of red blood cells and haemoglobin and therefore necessary in order to prevent nutritional anaemia?
4) Trace what happens in the body to the iron from some greens, which you eat?

5) What kinds of foods could be used as a rich source of iron for: babies, adult who is a vegetarian, adult who is non-vegetarian, very ill patient with fever who is on liquid diet?

6) What two kinds of healthy individuals will need extra iron in their diet? Why?

7) It has been said that white foods do not produce red blood. What do you notice about the colour of foods rich in iron?

C. IODINE

The total iodine content of the adult body is less than 30 mgms of which more than half is found in the thyroid gland which consists of two lobes situated or placed on either side of the trachea near the base of the neck.

1. Function

Iodine is an important constituent of thyroxine, the hormone secreted by the thyroid gland. This hormone is largely responsible for regulation of growth. Iodine is therefore a constituent of soft tissue and has a regulatory function in the body.

When the body does not get enough iodine for its needs, the thyroid gland enlarges to try to overcome the deficiency and this causes the swelling known as simple or colloid goitre. In the past this was common in many areas of the world where the iodine content in soil and water is deficient, and therefore of plant foods, is low. One such region is the Himalayan Mountains of North India.

One way in which this type of goitre can be prevented is by adding iodine in the form of potassium of sodium iodine to common salt used at the table. This must be done as an industrial process before the salt is sold in the market. One part of potassium iodate added to 1,00,000 parts of sodium chloride, as 'iodised salt' provides sufficient iodine to prevent simple goitre.

Simple goitre due to iodine deficiency must not be confused with

exophthalmic goitre, due to over activity of the thyroid.

2. Absorption and metabolism

Iodine absorbed from the small intestine is quickly taken up by the thyroid gland where it is used for the production of thyroxine. Some of the hormone remains in the gland while some is distributed to the body tissues to help in the control of metabolism.

3. Requirements and sources

The amount of iodine needed by the body is 0.15 to 0.2 mg for adults and 0.05 to 0.10 for infants and children. This is normally supplied by an ordinary well balanced diet and drinking water. It is, however, known that the iodine content of foods is greater where there is iodine present in the soil, as in areas near the sea. All sea foods are rich in iodine.

D. SODIUM, POTASSIUM AND CHLORINE

Sodium, potassium and chlorine are all present in foods and are required for normal functioning of the body. In their functions these three substances are related to one another. Potassium is present mainly inside the cells of blood and soft tissues, while sodium is present mainly in the fluids bathing the cells, i.e., in blood plasma and tissue fluid.

1.Functions

All three of these elements are necessary for the carriage of carbon dioxide by blood, from the cells where it is produced to the lungs where it can be excreted.

Sodium is very important for regulating the movement and use of water within the body, because it helps to maintain osmotic pressure.

Chlorine is necessary for the manufacture of hydrochloric acid for gastric secretion.

Sodium, potassium and calcium assist in correct functioning of muscles during contraction.

2. Sources

Sodium chloride, being used in cooking and as table salt, is usually taken in adequate quantities in normal nutrition, and there is little likelihood that the daily intake will be insufficient. In diet therapy it is sometimes necessary to restrict or limit the intake.

Potassium is present in almost all foods, even when refined, e.g., white flour, and the daily intake is thus sufficient for the body's needs. It is difficult to remove potassium from food when a low intake is required, without also spoiling the taste of the food.

E. OTHER INORGANIC ELEMENTS

There are other inorganic elements, which are generally considered as essential for animal nutrition, but are needed by the body only in very small amounts.

Copper functions with iron in the formation of haemoglobin. It is not actually present in the haemoglobin, but appears to act as a catalyst to enable iron to combine with protein.

Manganese has an effect similar to though less marked than copper.

Cobalt is present in Vitamin B12, which is also necessary for the formation of haemoglobin.

Zinc is found mainly in pancreatic tissue and may have an important part to play in the storage in insulin in the gland. The active part of this hormone consists of protein but it will crystallise in the presence of salts of zinc.

These elements are needed in such small amounts that any diet which has adequate quantities of other essential nutrients is not likely to be deficient in these 'trace' elements. The same may be said about any other 'trace' elements whose presence in the human body may not yet have been discovered. It is not necessary to consider any special source of these elements in the diet, as in the case of the inorganic elements required in much larger quantities.

QUESTIONS FOR STUDY

1) What process in the body does iodine help to regulate?
2) What happens when the iodine in food is not sufficient for body needs?
3) In what two ways may iodine intake be increased?
4) In what place in India is there a lack of sufficient iodine?
5) Where are potassium, sodium and chlorine found in the body?
6) Which mineral is important in maintaining osmotic pressure? In making of hydrochloric acid in the stomach? In the making of haemoglobin from iron and protein? In storing insulin in the body? Which minerals are found in table salt?

CHAPTER 5

FOOD FOR PROTECTION AND REGULATION OF THE BODY

I. FAT SOLUBLE VITAMINS

INTRODUCTION

The third main function of food is for protection and regulation of the body. Among the foods necessary for growth and repair of the body, protein and inorganic elements have been studied, but these nutrients also have protective and regulatory functions, e.g., lack of these nutrients cause deficiency conditions, which upset the normal functioning of the body. A further group of substances must now be considered.

In the development of the science of nutrition it was soon learned that substances besides carbohydrates, protein and fat were necessary for the health of the body. These were at first called accessory food factors, and their nature and chemical structure were then unknown. Later, the name was changed to 'vitamin' and during the last 50 years much work has been done to identify and determine the functions of these substances.

Characteristics of vitamins

It is difficult to give an exact definition of vitamin. Substances which function as vitamins for animals may not all be necessary for the human body; substances essential for man may not all be essential for animals. The following general statements may be made but do not cover all vitamins.

1) A vitamin is an organic compound essential for the maintenance of life.

2) A vitamin cannot be made in sufficient quantities in the body of the organism requiring it.

3) A vitamin is required only in small amounts.

4) A vitamin does not itself supply energy to the body, and it does not provide material for tissue building or general storage.

5) A vitamin functions as a catalyst either for the production of energy, for the working of certain enzymes or for the regulation of metabolism.

Classification of vitamins

There are two main classes of vitamins:

1) Fat-soluble vitamins

Vitamins A, D, E, K, and the essential fatty acid sometimes referred to as Vitamin F.

2) Water-soluble vitamins

Vitamins of the B Complex-Thaiamine, Riboflavin, Nicotinic Acid, Pyridoxine, B11 or Folic Acid, and B12.
Vitamin C or Ascorbic Acid.
Vitamin P or Hesperidin.

FAT-SOLUBLE VITAMINS

A. VITAMIN A

Night blindness is now known to be due to deficiency of vitamin A. Night blindness has been known for many centuries, and as early as 1600 BC liver was recommended as a cure.

Several other functions of this vitamin have now been determined.

1. Functions.

(i) It is necessary for the health of the eyes.

(a) For the prevention of night blindness.

(b) For the prevention of xerophthalmia.

There is in the retina of the eye a pigment known as visual purple, which is essential for seeing in dim light or twilight. This pigment is

whitened by the action of light, either during the day, or in a brightly-lit room, but must be converted again into visual purple in order that a person may see in dim light. For this conversion, the substance necessary is Vitamin A, oxygen, riboflavin and an enzyme present in the cells of the retina. If the body does not receive enough Vitamin A, night blindness results and may cause trouble. It is common knowledge that when a person passes from a brightly lit room to a dimly lit room, or out into the night, it is at first difficult to see clearly. A normal person can begin to see his way in a minute or two, but if he cannot see well after a few minutes, he, may be said to suffer from night blindness.

Xerophthalmia means 'dry eye' and refers to the rapid drying of the eye when it is held open when a person is deficient in Vitamin A. Infection and inflammation often follow this condition. If the condition is not treated, permanent blindness may result.

(ii) Vitamin A is necessary for the maintenance of the normal epithelial tissues of the body.

One of the important functions of the epithelial, the cellular membranes covering the free surfaces of the body, is to guard against the entrance of germs of diseases. If the body is deficient in Vitamin A the cells of the epithelial become hardened and flattened due to the presence of keratin, a hard protein substance. The surface layers of cells may then flake off or become infected. This may occur in the eyes, as already indicated, in the condition of xerophthalmia; ducts og glands and bronchi may become blocked with the flaking cells and later may get infected; the protective enamel of the teeth may become affected before the teeth protrude from the gums. Vitamin A has sometimes been called the 'anti-infective' Vitamin because of its protective action on the epithelial tissues of the body.

(iii) Vitamin A is necessary for growth, and the proper utilization of protein. It helps the body to fight against infections and is necessary for the proper development of the skin, eyes, bone and the nervous system. It is known to be involved in many aspects of metabolism.

2. Absorption and storage

Vitamin A is absorbed from the small intestine and fat or bile salts are thought to be necessary. Most of the vitamin is stored in the liver.

3.Requirement

Some scientists say that the body's requirement of vitamin A is roughly proportional to weight but the amounts recommended in India for all age groups are given on page 98.

4. Sources

Vitamin A is obtained from animal and plant sources. In animal sources it is associated with fats, but not with all fat. The main foods supplying it are milk, butter, cheese, and egg yolk, liver, fish and fish liver oils.

In plants there is a yellow pigment named carotene, and when eaten, such plants can supply Vitamin A to the body. About 50 percent of the carotene content of food are converted to Vitamin A in the walls of the small intestine, due to the action of an enzyme. Carotene is present in:

All dark green leafy vegetables.

Red and yellow fruits and vegetables, e.g., carrots, tomatoes, red, peppers, mango, papaya, jack fruit.

5. Stability

Vitamin A is fairly stable in all methods of food preparation. It is insoluble in water and not easily destroyed by heat, though there may be some loss in prolonged boiling of milk and stewing of vegetables.

6. Factors limiting the use of vitamin A

Vitamin A is not lost or destroyed in food preparation but the body is not always able to absorb or use the vitamin properly. The following points should be noted:

(i) Vitamin A and carotene are soluble in medicinal liquid paraffin

so that if this substance is used regularly to assist bowel action, much of Vitamin A may be lost in the faeces instead of being absorbed.

(ii) All diseases, which interfere with the digestion and absorption of fat, may also limit the amount of Vitamin A absorbed.

(iii) Increased requirements of Vitamin A may be necessary in fevers and in diabetes mellitus.

(iv) Protein seems to be needed for the absorption, storage, transport and utilization of Vitamin 'A' and for the efficient conversion of Carotene to Vitamin A. Children suffering from Kwashiorkor may fail to absorb Vitamin A given orally unless their protein status is improved.

(v) Hypervitaminosis A:

Excessive consumption of Vitamin A is found to result in several disorders. The skin becomes rough and thick and the bones become soft and fragile. Headache, irritability and vomiting are other symptoms. Excess Vitamin A interferes with the utilization of Vitamin K resulting in an increased tendency to bleed. Ordinary diets based on natural foods do not result in hypervitaminosis as the symptoms are found only when the amounts consumed are about hundred times more than those consumed normally. Hypervitaminosis A may also result if children are given shark or halibut liver oil in place of cod liver oil over a long period of time. The former contains much more Vitamin A (2500-3600mg/g) than the latter (300-1800 mg/g).

QUESTIONS FOR STUDY

1) Which nutrients help to protect and regulate the body?
2) In what ways are vitamins different from other nutrients?
3) What are the two main classes of vitamins?
4) How does Vitamin A promote health of the eyes? Of the epithelial tissues?
5) What undesirable effect on body nutrition may be produced by the frequent use of liquid paraffin for relief of constipation?

6) What is the chief characteristic of the animal sources of Vitamin A? Of the vegetables sources?

B. VITAMIN D

The early history of Vitamin D is closely linked with the history of rickets, which was recognized as a disease in the 17th century. Fish liver oil and butter were known to help in curing this condition but later these remedies were forgotten. Much work was done following the First World War among children who developed rickets during the war, and finally a relationship was discovered between rickets, sunlight and food.

Ten or more forms of the Vitamin are known but only two are of importance in nutrition namely cholecalciferal (Vitamin D3) and ergocalciferol (Vitamin D 2). Cholecaliferal is formed from the action of certain sterols (7-dehydrocholesterol) present in the skin of animal body during exposure to sunlight. Ergocalciferol is formed from ergosterol, a substance related to fat present in plants with ultraviolet irradiation. This action of sunlight and also of ultra-violet light is known as irradiation. As Vitamin D can be synthesized in the body with adequate exposure to sunlight it is not generally needed in the diet. However, when such exposure is restricted because of living in dark, poorly ventilated houses, a deficiency may result. Deficiency is often found in young children who are kept indoors most of the time. It was also found in women under 'purdah' (veil).

1. Functions

(i) Vitamin D is necessary for the proper calcification of bone, and thus for the prevention of rickets. It is not yet definitely known whether the action of Vitamin D assists the absorption of calcium from the small intestine, or its use in the bones, or whether it is concerned more with the metabolism of phosphorus, but in some way, calcium, phosphorus and Vitamin D are closely linked in the process of calcification of bone. It must be remembered that both calcium and Vitamin D are necessary. Adequate amounts of either

one cannot make up for a deficiency of the other.

(ii) Vitamin D affects the rate of growth.

(iii) Deficiency of Vitamin D causes late eruption of teeth, but it does not appear to affect the structure of teeth in the same way as it affects the structure of bones.

2. Absorption and storage

Vitamin D is absorbed from food in the small intestine and, as with Vitamin A, bile salts appear to be necessary. The human body apparently has no power to regulate the amount absorbed and if very large doses are given, the body may absorb too much. If this is also associated with an excessive intake of calcium, serum calcium increases and calcium is deposited in soft tissues such as the kidney, heart eyes and abdomen. The joints become swollen and stiff and muscular movements difficult and painful. In such cases a diet devoid of Vitamin D and low in calcium should be promptly introduced.

Vitamin D is also absorbed into the body from the skin after exposure to sunlight or ultra-violet light.

After absorption Vitamin D may be stored in various parts of the body.

3. Requirements

It is not known how much Vitamin D is required by the body. About 400-800 i.u., are considered sufficient for young children. Pregnant women and nursing mothers, growing children and adolescents all need Vitamin D for bone development, but in India it is assumed that adults should be able to get adequate Vitamin D from sunlight. Women who live in the seclusion of purdah may not get enough from sunlight.

4. Sources

Sunlight is the main source of Vitamin D for man. The action of sunlight may be by direct irradiation of the body, or through foods in which Vitamin D has been produced by irradiation. The chief of such

foods are milk, butter, cheese, egg, fish, and fish liver oils, and foods which have been fortified by addition of Vitamin D. If very large doses of Vitamin D have to be administered, it is considered safer and less liable to cause toxic symptoms to use a natural food source, e.g., fish liver oil, than to use concentrates, prepared as medicine.

5. Stability

Vitamin D is stable in all home methods of food preparation but may be destroyed by over-irradiation.

C. VITAMIN E

The value of Vitamin E in human nutrition is still uncertain. Our knowledge of its functions is based on animal experiments, chiefly with rats, but there is no certain evidence that the Vitamin has the same functions in similar conditions in the human body. The chemical name given to it is *tocopherol,* from the Greek word meaning 'to bear children.

1. Functions

(i) Vitamin E is necessary for reproduction in rats. Deficiency causes sterility in the male rat, and in the female rat, the inability to carry pregnancy to the full term of 21 days.

(ii) Vitamin E is necessary for growth in rats.

(iii) Vitamin E is necessary for normal muscular function.

(iv) Some workers consider that Vitamin E is necessary for the normal use of Vitamin A and carotene in the animal body. Vitamin E is often used in treatment of women who have repeated abortions but there is no definite evidence that a later normal birth of a child is due to the treatment with Vitamin E.

There are also conditions of improper muscular function in human beings, more common in males than in females which, have been treated apparently successfully with Vitamin E, but not all such cases improve with this treatment.

2. Absorption

As with other fat-soluble Vitamins, fat and bile salts appear to b
necessary for the absorption of Vitamin E.

3. Requirements

Requirements are estimated to be between 10-30 mgm and found to depend on the polyunsaturated fatty acids in the diet. This amount is easily obtained if a balance diet is consumed.

4. Sources

Fats of vegetable origin, and food grains (e.g. wheat germ) are rich sources of Vitamin E. However, coconut oil has much less Vitamin E than other oils. Oil seeds whole grains and dark green leafy vegetables are also good sources for the Indian diet.

5. Stability

Vitamin E is not destroyed in ordinary home cooking unless it comes in contact with rancid fat. It has been suggested that the vitamin may be destroyed in the stomach by the present of rancid fat left from the previous meal.

D. VITAMIN K

Nearly 30 years ago it was realised that a food factor was necessary to prevent a haemorrhagic disease in chickens. Such a condition could not be cured by giving lemon juice, pure Vitamin C, Cod liver oil or wheat germ oil-foods containing the other known vitamins. Eventually the factor was isolated and its function in preventing haemorrhage was found to be associated with the production of prothrombin in the body. It was called Vitamin K from the Danish spelling of the word Koagulation, since prothrombin is necessary for the coagulation of blood.

1. Functions

Vitamin K is necessary for the coagulation of blood. Deficiency of this vitamin, especially in the newborn, may cause a fatal haemorrhage.

2. Absorption and storage

The natural nutrient fat-soluble vitamin requires bile for its absorption, but there are also water-soluble substances with a similar action, which can be absorbed without bile if given in large doses. The vitamin is stored in the liver but in small amounts, which may be used up if there is no further intake.

3. Requirements

The requirements of this vitamin are not known. In the adult, bacterial action in the intestine may produce adequate amounts for the body, but additional amounts are probably necessary for pregnant women in order to prevent the haemorrhagic condition developing in the newborn child.

4. Sources

Sources of Vitamin K in human nutrition are green leafy vegetables and muscle meats. It is also found in tomatoes but not in other fruits. In a normal adult it may be produced in the small intestine by the action of bacteria.

5. Stability

Vitamin K is a fat-soluble vitamin, stable in boiling water, but destroyed in the presence of alkali. Use of soda bicarbonate in cooking may therefore cause destruction of the vitamin.

E. ESSENTIAL FATTY ACIDS

It has been mentioned earlier that fats contain factors necessary for the protection of the body. These factors are mainly the fat-soluble vitamins, but there are also three fatty acids which are now thought to be essential for the body whose function appears to be

similar to that of the vitamins. Linoleum acid, linolenic acid and arachidonic acid are known as the essential unsaturated fatty acids. Although all three of these are considered essential, linoleic acid is the only one we really need as the other two can be synthesized in the body from the same.

The function of these organic acids in animals and possibly also in man, is connected with the transport and metabolism of cholesterol, a substance produced in the body during the metabolism of fat. They have also been used successfully in the treatment of toad-skin.

The essential unsaturated fatty acids are not present in most fats of animal origin, and not in all vegetable fats, but they are present in gingelly oil, groundnut oil, and linseed oil.

QUESTIONS FOR STUDY

1) What is meant by irradiation? How is it of importance in the study of Vitamin D?
2) What else besides Vitamin D is necessary for the prevention of rickets?
3) What kind of individuals has special need for Vitamin D?
4) Why is there no need for anyone in India to have a deficiency of Vitamin D?
5) When is Vitamin K of special importance?
6) What are the possible functions of Vitamin E?
7) What may be the value of essential fatty acids in the body? In what foods may they be found?

II. WATER-SOLUBLE VITAMINS

The water-soluble vitamins include all those of the Vitamin B Complex, Vitamin C and Vitamin P. The Vitamins of the B complex, which are important in nutrition, are:

Thiamine	Vitamin B1
Riboflavin	Vitamin B2
Nicotinic acid	
Pyridoxine	Vitamin B6
Pteroylglutamic acid	Folic Acid, Vitamin M or B11
Cyanocobalamine	Vitamin B12

1. VITAMIN B COMPLEX

A. VITAMIN B1 OR THIAMINE

Knowledge of the action of this vitamin dates back to the last 20 years of the 19th century. Beri-beri is a disease, which has been known in the East for centuries, but the modern knowledge of it dates from the use of steam-mills for the milling of rice. In 1882 a Japanese admiral reduced the number of cases of beri-beri in the Japanese navy by adding meat, fish, vegetables and barley to the regular diet. Later, in Java, beri-beri was cured by the use of bran and rice polishing. Experimental work at the beginning of the present century confirmed these findings and led to the isolation of the vitamin. One name given to it was aneurin, from [1]anti-polyneuritic vitamin, but the name Thiamine is preferred because it indicates the sulphur and amino group present in its structure.

[1]Anti-polyneuritic--against inflammation of nerves,usually more than two

1. Functions

(i) Thiamine aids carbohydrate metabolism as a catalyst and thus prevents beri-beri.

(ii) Thiamine is also necessary for the transmission of nerve impulses.

(iii) It may be necessary for growth, though this action is probably through the normal metabolic processes.

In deficiency of thiamine, the effect is most noticeable in the nervous system, which uses only carbohydrate for its metabolism. This is largely the cause of the mental symptoms and paralysis associated with beri-beri.

Thiamine is not well absorbed when there is any abnormality of function in the gastrointestinal tract. In diseases with diuresis the vitamin may be 'washed out' from the tissues.

2. Absorption and storage

Thiamine is rapidly and completely absorbed in the small intestine under normal conditions. It is found in all tissues, especially heart, brain, kidney and liver which are tissues very active in metabolism, but it is not stored for any length of time in the body.

3. Requirements

The requirement of thiamine is related to the total Calorie intake and especially the Calorie intake from carbohydrate foods. A diet high in carbohydrates, such as rice diet, results in a high requirement of thiamine for assisting in its metabolism. If the quantities of fat and protein in the diet are increased, and the carbohydrate is decreased by a quantity equal in Calories value, then the thiamine requirement is decreased. Fat and protein are therefore known as sparers of thiamine in the diet.

4. Sources

Unlike other vitamins, there are few sources that contain large amount of thiamine. Therefore, in order to obtain the total daily requirement of

thiamine, a person must eat many different foods, each providing only a small amount of thiamine but together giving the necessary total amount. Rice is not a good source, but if it is used regularly, parboiled rice and home-pounded rice are better than raw and milled rice. Other whole-grain cereals, especially wheat and ragi, should be used daily in addition to rice.

Pulses (dhal), vegetables, and potatoes are useful sources because of their common use. Green leafy vegetables and good helping of a variety of other vegetables should be included in the diet every day.

Flesh foods are not very good sources, but liver will provide some thiamine in addition to many other nutrients, which it contains.

5. Stability

Thiamine is fairly stable to dry heat but it is easily lost by dissolving in the water food is cooked in and may be destroyed if alkali, such as soda bicarbonate, is used in food preparation.

The relationship of thiamine to other vitamins of the B Complex is important, (see page 150).

B. RIBOFLAVIN

The substance now known as riboflavin was first reported as a 'yellow enzyme' obtained from yeast, a substance that possessed a yellow-green fluorescence and was necessary for growth. It was easily recognized as differing from thiamine and was therefore called Vitamin B12, but the name riboflavin was given later when it was found to have a structure related to ribose (a sugar) and the group of chemical substances called flavones.

1) Functions

Riboflavin is an enzyme, which is necessary together with thiamine and nicotinic acid, for metabolism of carbohydrate. Riboflavin is connected particularly with the metabolism of lactic.

If the metabolism of carbohydrate is incomplete because of inadequate riboflavin, it leads to the symptoms characteristic of deficiency of riboflavin, connected mainly with the eyes and mouth.

2. Absorption and storage

Riboflavin is absorbed in the small intestine and hydrochloric acid is apparently necessary. The vitamin is not well absorbed in gastrointestinal diseases. After absorption, the vitamin is stored in liver, kidney and heart tissues, which have a high rate of metabolism.

3. Requirements

Various figures have been given for the requirements of riboflavin. Animal experiments indicate that the requirement is related to sex, age, and degree of activity and calorie intake. Further research is necessary to decide the required intake and, whether production in the human body may provide an adequate amount.

4. Sources

The best sources of riboflavin are the tissues in which it is stored, particularly liver and kidney. Milk may be a valuable source if taken in large quantities, and green leafy vegetables also contribute to the daily intake. The riboflavin content of green leafy vegetables is highest in the young growing shoots, so that milk from cows fed on fresh young grass usually contains more riboflavin than milk from cows fed on older pasture. The use of parboiled rice, and frequent use of fermented food (e.g. Idle, dosai) and sprouted grams will increase the intake of riboflavin in the diet.

5. Stability

Riboflavin is classified as a water-soluble vitamin but is actually only slightly soluble in water. It is stable in acid solutions, but unstable in the presence of alkali, e.g., soda bicarbonate used in cooking, in bright sunlight, and in ultra-violet light irradiation.

For relationship of riboflavin to other B Vitamins, [see page 154].

3. NICOTINIC ACID

Nicotinic acid has been known as a chemical substance for many years, but it is only within the last twenty-five years that it has been recognized as an essential factor in human nutrition. It has now

been identified as a substance with enzyme activity concerned with processes of oxidation of food substances in cells.

It is known also by the name nicotinic acid amide, nicotinamide and niacin.

1. Functions

(i) Nicotinic acid functions as a co-enzyme along with thiamine and riboflavin in the oxidation of carbohydrates, and also in the metabolism of protein. This is especially important in the metabolism of protein and in the metabolism of carbohydrate in the central nervous system. Pellagra is often known as the nicotinic acid deficiency disease. It is accompanied by mental disturbance, and it is thought that this may be due to the inadequate carbohydrate metabolism in the absence of nicotinic acid.

(ii) Nicotinic acid is known to stimulate the formation of red blood cells in rats, and there may be a similar action in man.

2. Absorption and storage

Nicotinic acid is present in foods mainly as the co-enzyme, which functions in metabolism in the body. It is not known whether it is absorbed in this form or is changed before absorption. The vitamin is present in all tissues of the body, especially in the liver.

3. Requirements

Estimates in India recommend an intake of 15-23 mg for an adult man. It is generally agreed that further work is necessary to determine the requirements of nicotinic acid.

4. Sources

The tissues in which nicotinic acid is stored in nature form valuable sources of the vitamin, and this is particularly so with liver. Yeast is an even richer source but not readily available except in the form of prepared tables.

Wheat and rice contain less nicotinic acid than some of the flesh foods, but may contribute quite a large amount to the daily intake of

the vitamin because of the quantities of cereal eaten. Potatoes, greens, and some of the fruits contribute smaller quantities.

5) Stability

Nicotinic acid is soluble in hot water, but is one of the most stables of all the known vitamins. It is not oxidized or destroyed in ordinary cooking processes, nor by exposure to light or air. It can be autoclaved and thus made safe for intravenous injection without losing its strength.

INTER-RELATIONSHIP OF THIAMINE, RIBOFLAVIN AND NICOTINIC ACID.

All these three vitamins function in carbohydrate metabolism and are thus related to each other. For many years, their functions have been regarded separately as specific for the deficiency diseases associated with inadequate intake of the vitamins, but it is now known that there may be much more relationship to each other in the prevention of deficiency diseases than was formerly thought.

Pellagra may suddenly become apparent if there is a sudden increase in metabolism, as in pregnancy or forced labour, on a diet which had previously kept the person free from open deficiency. For the cure of pellagra, all three vitamins are necessary.

In deficiency of thiamine, there is usually also deficiency of riboflavin, due to poor absorption of the latter. On the other hand, large doses of thiamine alone lead to increased excretion of riboflavin and nicotinic acid and may therefore lead to symptoms of deficiency of riboflavin or nicotinic acid.

It seems therefore, that a balance must be maintained between these three vitamins, and therefore they are usually given together medicinally as Vitamin B Complex.

When thiamine is deficient, giving large doses of Vitamin A will often make the condition worse.

4. *FOLIC ACID AND VITAMIN B 12*

Folic acid (or pteroylglutamic acid), and Vitamin B12 (or cyanocobalamine) are not chemically similar but they function together in helping in the formation or red blood cells.

Anaemia due to iron deficiency has already been mentioned but there are other types of anaemia in which the circulating red blood cells are larger than normal and not properly developed. Iron alone is not adequate in treatment for these anaemias. For many years liver has been known to benefit these types of Anaemia.

In 1941, Folic acid was isolated, and found to be effective for most types of anaemias not due to iron deficiency but it did not have a permanent effect upon the blood in pernicious anaemia; nor affect the nervous symptoms associated with pernicious anaemia factor. Then a new vitamin, now known as Vitamin B12 was isolated and found effective for the blood condition, gastro-intestinal symptoms and nervous symptoms of pernicious anaemia.

1. Functions

The way in which these two factors function is not yet clear. It is known that Vitamin B12 has something to do with the metabolism of fat and carbohydrate, and is necessary for the proper function of nerve cells.

2. Absorption and storage

Folic acid is present in nature mainly in combined forms and the way in which it is broken down and absorbed is not known.

Vitamin B12 formerly known as the extrinsic factor of *Castel* requires an enzyme-like substance, the intrinsic factor, present in gastric juice for its absorption. Vitamin B12 deficiency does not seem to be a problem in India.

3. Sources

Liver and green leafy vegetables are the best sources of folic acid in the Indian diet. It is believed that folic acid requirements are

increased during pregnancy. So it would be wise for pregnant women to eat lots of green leafy vegetables, which contain other important nutrients also.

OTHER FACTORS OF THE VITAMIN B COMPLEX

Pyridoxine or Vitamin B6

This substance is necessary for growth and for prevention of dermatitis in rats. It is absorbed and excreted in man and may be connected with protein metabolism, but a naturally occurring deficiency has not been shown.

Pantothenic Acid

Pantothenic acid is known to be necessary for some of the metabolic processes in the body, but it is not known whether it must be supplied in the food, or whether it is adequately produced in the body.

Choline

Choline is necessary to prevent the accumulation of fat in the liver of rats, and does take part in human metabolism. A dose of 1gm. daily is needed for therapy, and this is large compared with the requirement of all the known vitamins. The diet commonly consumed contains adequate amounts of Choline.

Biotin

It has been known for many years that if raw egg white is given in large quantities to experimental animals, a toxic effect is produced. Later certain foods, especially liver and yeast, were found to contain an organic substance now known as Biotin necessary to protect rats against this injury. Avidin, a protein present in large amounts in uncooked egg white combines with biotin in the intestine and thus prevents its absorption. This leads to 'egg white injury' characterised in rats by conjunctivitis, dermatitis, and loss of hair and abnormal posture.

Biotin is necessary for the growth of bacteria, and appears to be

connected also with carbohydrate and fat metabolism in the body. The biotin content of rapidly growing tissues, e.g., in embryo and tumours, is very high.

Deficiency is unlikely to occur in human beings but one case has been reported in an Italian labourer who habitually ate about six dozen raw eggs per week.

Biotin is a very stable vitamin.

QUESTIONS FOR STUDY

1) How has the use of mills for milling rice affected knowledge of thiamine? Why do you suppose this is so?
2) Why should a thiamine deficiency especially affect the nervous system?
3) Some persons may appear to be eating a diet adequate in vita mins but may still show signs of deficiency. What factors may cause this?
4) Why is thiamine especially important in the diet of rice eaters?
5) What kind of foods is necessary in the diet to provide thia mine?
6) Explain how the following are related to each other:

   Riboflavin and nicotinic acid
   Glucose and thiamine
   Pyridoxine and protein
   Folic acid and Vitamin B12
7) Why are the B Complex vitamins more often given together than separately when there are signs of a deficiency of one of them?
8) What is the possible function of each of the following in human nutrition:
   Folic acid, Vitamin B12, Pyridoxine, Panthothenic acid, Choline.

2. VITAMIN C OR ASCORBIC ACID

The history of Vitamin C is linked with the deficiency disease scurvy, which was first recorded in the 13th century and is characterized by weakness and pain in the limbs, multiple haemorrhages, bleeding from the gums, loosening of the teeth, and an increased liability to infections. In the middle ages, scurvy was very common among seamen who were away from land often for months at a time and had no fresh food. It was also common in Europe, but introduction of the potato into Europe in the 17th century made the disease less common. In the 19th century the British Navy issued lemon juice to its sailors daily to prevent scurvy.

At the beginning of this century, two Scandinavian scientists tried to produce beri-beri in guinea pigs by feeding a deficient diet, but produced scurvy instead. This was an important discovery because it was thus found that guinea pigs could be used for estimating the varying amounts of food substances that were necessary to cure scurvy. It was not until 1932 that the Vitamin was isolated and its structure determined.

1. Functions

(i) Ascorbic acid is necessary for the inter-cellular cement substance that holds together the cells of tissues, including dentine, cartilage and the matrix of bone. This is particularly important in the guinea pig, an animal whose teeth is always growing but may not be of the same importantance in man, whose teeth stop growing when they are fully formed. Deficiency of ascorbic acid does, however, produce pains in the joints in man in scurvy, and this may be a common symptom before the severe deficiency disease is apparent. Lack of inter-cellular substance in the walls of capillaries may lead to bleeding into the tissues and easy bruising.

(ii) Ascorbic acid is necessary for the healing of wounds. This is because the inter-cellular substance is necessary for the repair of the tissues and affects the strength of scar tissue. In the absence of ascorbic acid there is often bleeding into the tissues and cells are not properly formed.

(iii) Ascorbic acid is necessary for development of red blood cells, but the way in which this function is carried out is not clear.

(iv) It is necessary for growth.

(v) Ascorbic acid is sometimes called an anti-infective vitamin, probably because it helps to maintain normal tissues by the inter-cellular substance.

2. Absorption and storage

Ascorbic acid is absorbed mainly from the small intestine and absorption is better if the vitamin is taken with food. It is present in many tissues of the body and must be easily available when needed, because the early signs of deficiency are not so easily noted and it takes several months for scurvy to develop on a deficient diet. Any excess vitamin, which may be taken in large doses medicinally, is readily excreted from the body in the urine.

3. Requirements

The requirements recommended in India are:

Adults	50 mg per day
Children and adolescents	30-50 mg or more

Pregnant and nursing women should have more.

Comparing these requirements with the sources, it is seen that the daily requirements can easily be satisfied by small quantities of some of the richest sources.

4. Sources

The main sources of ascorbic acid are fresh fruits and green leafy vegetables, especially young growing shoots. Nellikai (amla) containing 560 mg per 100 gm is the richest source in India.

Other sources are:

Guava	212 mg per 100 gm
Drumstick leaves	220 mg per 100 gm

Amaranth leaves	99 mg per 100 gm
Cabbage	124 mg per 100 gm
Orange	30 mg per 100 gm
Papaya	57 mg per 100 gm
Tomato	27 mg per 100 gm

Other fruits and vegetables contain smaller quantities, which may still contribute to the daily intake. Dried peas, beans and dhal contain very little ascorbic acid, but if allowed to germinate, e.g., sprouted green gram, the vitamin content rapidly increases.

5. Stability

Ascorbic acid is the most unstable of all the known vitamins and may easily be lost or destroyed in food preparation. The pure substance is stable if dry and kept in the dark. It may turn yellow but this does not cause any loss of its nutritive properties. It may be lost in food preparation by its solubility in water, or by destruction due to the action of ascorbic acid oxidase, an enzyme present in foods along with the vitamin, or by keeping food hot for a long time after cooking, especially if sodium bicarbonate has been added during cooking. The ways in which loss may occur, and the methods of food preparation to prevent loss may be summarized as follows:

FOODS FOR PROTECTION AND REGULATIONOF THE BODY

Loss due to	*Method of preparation to prevent loss*
(i) Solubility in water.	(i) Use the minimum amount of water in cooking and use any strained water in any other preparation.e.g. sambar, rasam.
(ii) Action of ascorbic acid oxidase.	
(a) In wilting.	(a) Use food as fresh as possible.
(b) In exposure to air after fine cutting, shredding or grinding.	(b) Prepare food just before it is to be eaten or cooked.

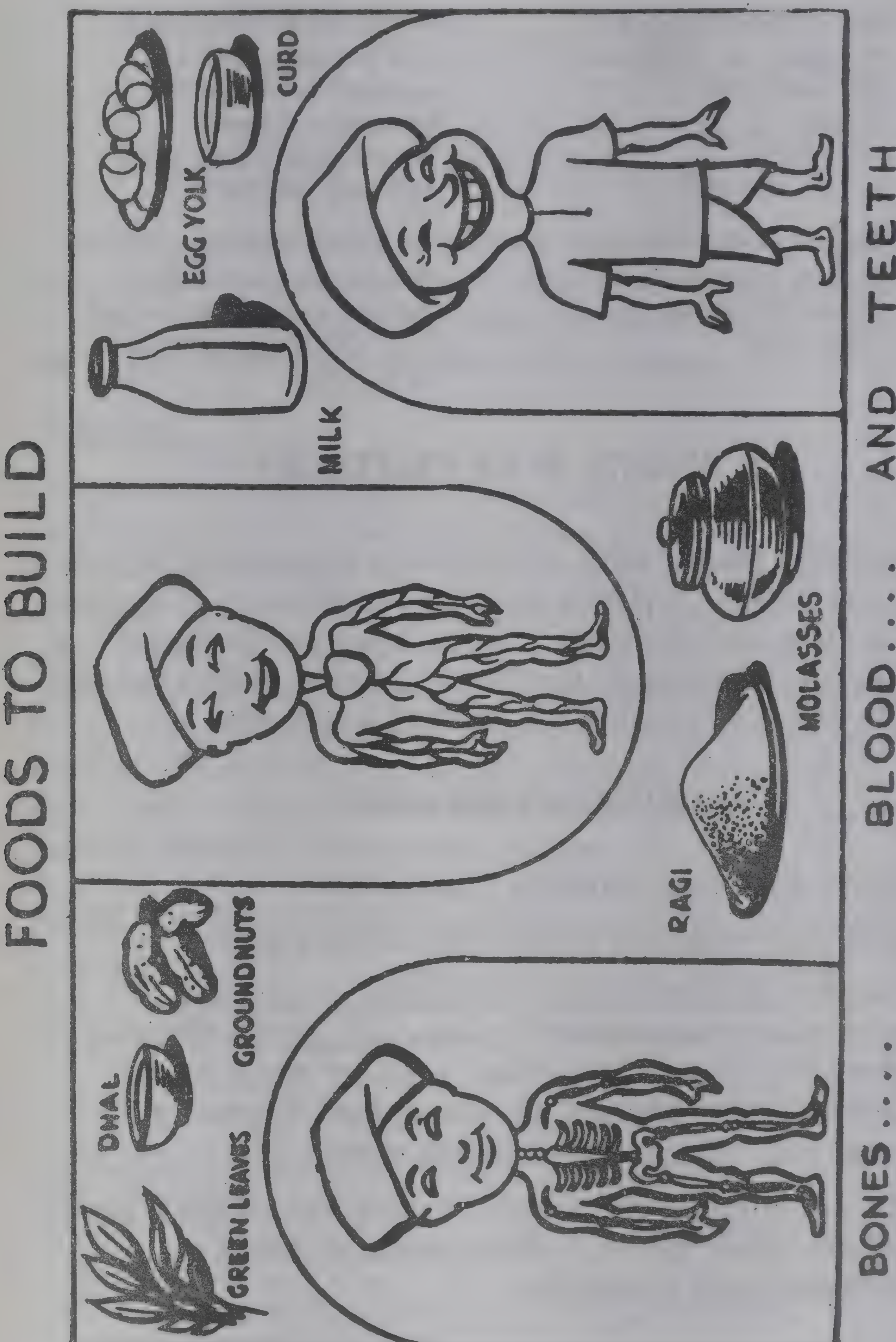
(c) By catalytic action of iron and copper on the Enzyme increasing destruction of vitamin.	(c) Do not use an iron knife in food preparation nor a copperpot which has not been properly tinned.
(d) Slow cooking.	(d) Put food into boiling water and cook quickly.
(iii) Keeping food hot after cooking especially if sodium bicarbonate has been used.	(iii) Do not use sodium bicarbonate in cooking. Arrange cooking time so that food is ready just when it is to be eaten.

3. VITAMIN 'P' OR HESPERIDIN

Vitamin P is another water-soluble vitamin found mainly in plants, fruits, and flowers. It plays a part in the maintenance of capillary walls, and is apparently necessary in man, in addition to Vitamin C. It is, however, obtained mainly from the same sources as Vitamin C, and therefore deficiency is unlikely if Vitamin C is adequate.

QUESTIONS FOR STUDY

1) What are the signs of Vitamin C deficiency?
2) What cheap sources of Vitamin C are available to all?
3) From the information about the stability of vitamins how would you advise a patient to prepare and cook the following in order to preserve their vitamin content? Which vitamin would bevaffected in each rule you suggest? Potatoes, green beans, rice, milk, tomatoes, cabbage, mutton.
4) Make a chart of all the vitamins, showing for each one in bare outline: names, sources, stability, functions, effects of deficiency, daily requirements.



WHICH NUTRIENTS ARE FOUND IN EACH OF THESE FOODS?

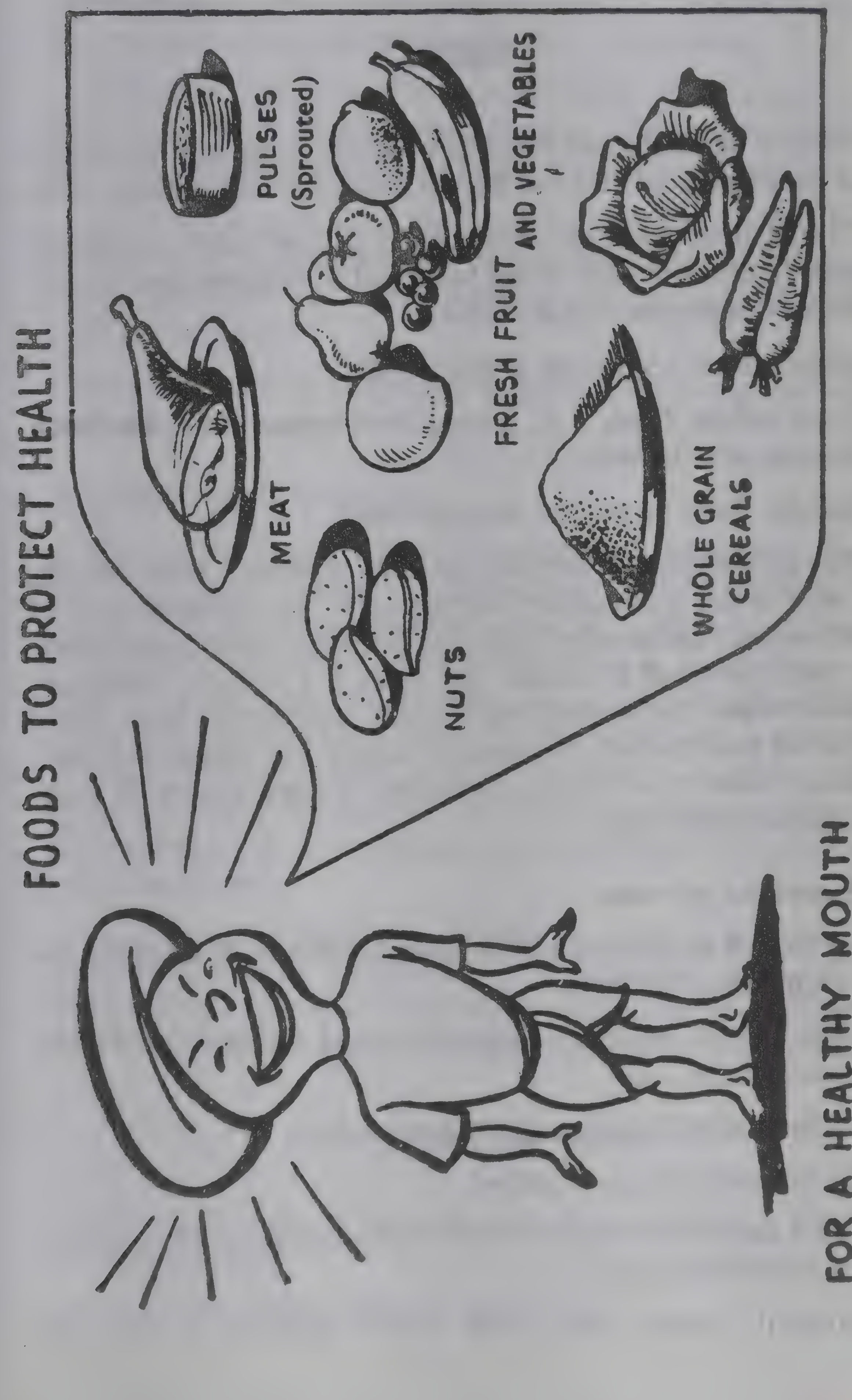
FIGURE 3

VITAMIN A

FIGURE 4

VITAMIN B COMPLEX

FIGURE 5



WHICH NUTRIENTS IN THESE FOODS WILL HELP GIVE A HEALTHY MOUTH?

FIGURE 6

CHAPTER 6

WATER

Water is more important to life than food since man may live without food for several weeks but can live for only a few days without water.

The adult weight is approximately 70 percent water, the amount varying in different parts of the body, and in different tissues. It is distributed approximately as follows:

Blood stream 3.5 percent of body weight.

Extra-cellular fluids, e.g., lymph, cerebrospinal fluid, eye fluids, 20 percent of body weight.

Cellular fluids 50 percent of body weight.

The gastrointestinal secretion amounts to about 7 litres per day, but most of this is reabsorbed into the body. The cerebrospinal fluid is also secreted and absorbed daily, but the exact quantity is unknown. Eye fluids are small in amount but there is a definite circulation. Urine is formed continuously and is a fluid lost from the body. Sweat is also lost from the body, the amount varying with climate and work. Oedema, when it occurs, is a symptom of some change in water metabolism in the body.

1. Functions of water

(i) Water is an essential part of blood, lymph and all the secretions and excretions of the body.

(ii)It aids in digestion, absorption and metabolism of food substances in two ways:

(a) By dissolving and transporting substances.

(b) By functioning as a catalyst.

(iii) It assists in the regulation of body temperature. This is carried out in the following ways:

(a) By its specific heat. More heat is required to raise the

temperature of 1 gm of water through 1°C than almost any other known solid or liquid. Thus heat produced in chemical changes in the body will cause only very slight rise in temperature.

(b) By heat conduction. Heat conduction of water is greater than that of any known liquid; therefore water is the best possible liquid for conducting heat away from the place where it is produced.

(c) By the heat used in the evaporation of water. Thus heat is removed from the surface of the body by evaporation with a cooling effect. This property of water is made use of in giving a cool sponge to a patient with fever.

(iv) Water acts as a lubricant to joints and mucous membranes, preventing friction.

2. Requirements of water

Water is lost from the body in faeces, urine, and through the skin and lungs. Water is supplied to the body as free fluid, which is drunk, by the water present in the foods eaten, by production in the body during the chemical changes which take place in metabolism, and by the fact that all tissues contain water. Comparison of figures estimating losses and sources of water shows that the body needs a minimum of 1 litre of free fluid per day in order to maintain life and excrete the waste products of metabolism. Additional quantities are required in hot weather and by persons doing hard manual labour, to make up for extra loss as sweat.

In infants, the percentage of water in the total body weight is higher than in adults. Infants are much more liable to sudden changes of body temperature than adults, and the possibility of dehydration is more likely. Infants require 165 ml of fluid per kg of body weight.

QUESTIONS FOR STUDY

1) How is the water in the body divided, i.e., where is it found and in what form?
2) How is the body's supply of water saved?

3) What are the functions of water in the body?
4) What other sources of water are there besides that which we drink as fluid?
5) How is water lost from the body?
6) Under what condition does the healthy adult require more than the normal intake of water?

CHAPTER 7

PLANNING AN ADEQUATE DIET

In chapters 2-8, it has been shown how the various nutrients have different functions, all of which are necessary for the health of the body. If a diet is to be adequate for the needs of the body, it must contain all the essential nutrients in the right amounts and correct proportion. Such a diet is known as a balanced diet. A balanced meal is one that has the right amount of body building protein, of energy-giving carbohydrates or fat, as well as, protective foods and minerals. One important thing about a balanced meal is that the foods are mixed-that is different foods are eaten together.

To plan a balanced or adequate diet, it is necessary to know the requirements of the body for the different nutrients. These have been given in the table on page 98 and have been discussed in detail under the appropriate headings. Total calories vary with the degree of activity, but it should be noted that for adults, the requirements of many nutrients are the same, whatever the activity although there may be slight variations with differences in weight.

There are much greater variations when the body has some special requirement, as for growth in children and adolescents, and for the nourishment, of both child and mother during pregnancy and lactation.

The foods necessary for an adequate diet, in relation to the nutrients they contain and the functions they serve, can be summarized briefly as follows:

(i) to supply heat and energy	Carbohydrates	Cereals, Sugars, Pulses.
	Fats	Nuts, Fats, Oils, Milk, Cheese.
(ii) for growth and repair	Proteins	Milk, Cheese,

		Meat, Liver, Fish, Eggs, Pulses, Nuts.
	Minerals	Milk, Green and other vegetables, Fruits.
(iii) for regulation and protection	Vitamins	Milk, Eggs, Liver, Green and other vegetables, Fruits.

1. Selection of foods to give all the nutrients

When selecting foods to give a balanced diet it is essential that the body's need for growth and repair and for regulation and protection should be satisfied *first*. The total calories may then be made up from other foods. This reverses the order in which the nutrients have been studied in this book. McCollum has said *Eat what you want after you have eaten what you should.*

In the summary given, it is seen that some foods help to satisfy the body's needs for more than one nutrient. Foods can therefore be divided in-groups so that selection of one or more foods from each group will result in a balanced diet. These food groups are:

(i) Protein foods

Milk and milk products (i.e. curds, buttermilk)

Pulses – dhal, gram, lentils, dried beans and peas

Nuts and oil seeds

Eggs

Fish

Meat -- Mutton, Poultry, Pork, and Beef.

(ii) Protective vegetables and fruits

(One or more from each of the following three groups).

Leafy green vegetables -- Amaranth, Radish tops, Spinach, Fenugreek, Drumstick leaves etc.

Yellow or Orange Fruits and vegetables -- carrot, pumpkin, papaya, and mango.

Vitamin C Rich fruits and vegetables -- Amla, Guava, Orange, Grape fruit, Sweeetlime, Pineapple, Tomato.

(iii) Other vegetables

Flowers, Fruits and Stems of plants.

i.e. brinjal, ladies finger, beans and peas, cucumber, gourds and onions.

(iv) Cereals, Roots and Tubers.

Rice, wheat, maize, jowar, bajra, ragi and others (cereals are more nutritious if atleast two different kinds are eaten at the same time).

Tapioca, potato, yam, sweet potato and colocasia.

(v) Fat, oils, sugars and jaggery -- vegetable oils, vanaspathi, ghee, butter, sugar, jaggery and honey. Fats and sugars are good sources of calories.

Condiments and spices contain some nutrients but are used mostly to give flavour.

In order to emphasize the importance of the other foods in the above diet, cereals are placed last instead of being considered first as is usually the case in Indian diet. It should be remembered also that one cereal, particularly rice, should not be used alone omitting other cereals. This is of particular importance in South India.

For vegetarians who do not take flesh foods, more pulses and dhal should be taken and an increased amount of milk must be used to make certain that approximately one-third of the total protein is obtained from animal sources. The dietary value of buttermilk, which is often very dilute, depends upon the quality of milk or curds from which it is prepared.

2. Balanced diet

A balanced diet calculated to meet the needs of the average adult is listed in *'page 97, 98 and 99'.*

Coffee and condiments and spices are not included in the calculation because they do not give much if any food value, but have their value in providing flavour and variety in the diet.

3. Other essentials of an adequate diet

Not only must the quantities of foods be adequate in all respects, but the food must also be acceptable to the person taking it. Other factors, which must be considered, are therefore:

(i) *Digestibility:* This depends largely upon the way food is cooked. Cereals and pulses must be well cooked so that the starch swells sufficiently to break the cellulose of the cell walls and thus allows for mixing of the digestive juices with the food. Care should be taken not to overcook flesh foods as this leads to hardening of the protein, making it difficult to digest. The amount of fat which people can take with their food varies greatly. The presence of a lot of fat in the stomach tends to depress the secretion of gastric juice, and for food to be easily digestible it may be necessary to reduce the amount of fat or oil or ghee used in cooking or to add it to food after cooking.

The digestibility of food is dealt with further in the section on Diet Therapy.

Cooking also serves to destroy harmful bacteria and parasites.

(ii) *Palatability:* Whether or not food appeals to a person depends partly on appearance but largely upon taste. There are variations in preparation of food amongst different classes, communities and races. This depends on the method of cooking and the amount of condiments and spices used. When deciding on the method of cooking to be used, the loss of vitamins must be avoided.

Some people must acquire or get used to the taste of certain foods before they are able to eat those foods. Others may dislike some foods because there is some prejudice or unpleasant association with the food, in their minds.

(iii) *Satiety Value:* Food must also be satisfying. This depends partly upon the actual bulk of the food eaten, and also upon the fat content of the food. Food with a high fat content stays for a longer time in the stomach and therefore delays the onset of the feeling of hunger.

4. Factors which influence food selection

The planning of an adequate diet has been discussed mainly from the nutritional point of view, but there are other social, religious and economic factors to be considered. The factors, which influence food selection, may be summarized as follows:

(i) Requirements of the family group, taking into consideration

(a) the composition of the family

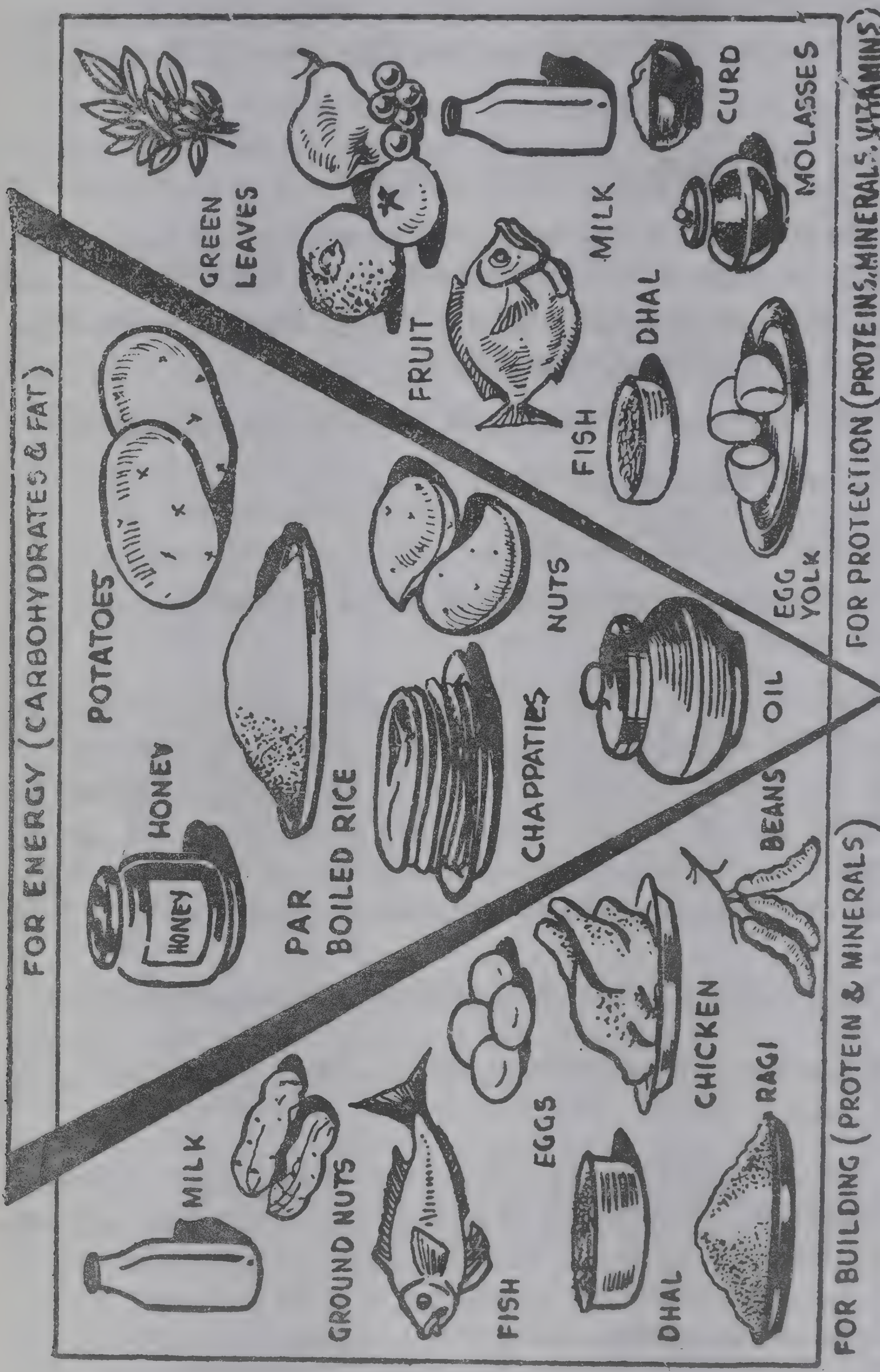
(b) the occupation of the adults

(c) special requirements for children, adolescents and pregnant and nursing mothers.

The nutrition of infants and young children needs special consideration and adjustment according to their needs in growth and development activities and ability to digest. This will be dealt with in **Volume IV** where there will be a section on pediatric nursing. The special adjustments in the nutritional requirements of the older adult according to the degree of their activities will also be dealt with in **Volume IV.**

(ii) Racial habits. Choice of food varies with the custom of different groups, communities and races, and may partly be determined by the availability of food. This in turn is dependent to a large extent upon soil and climate.

(iii) Religious practices. In different religions there are different laws regarding foods which may be forbidden, e.g., Hindus do not eat beef; Muslims and Jews do not eat pork. Therefore, apart from racial customs, adequate diets must be planned to meet the needs of non-vegetarians, vegetarians who eat eggs, and vegetarians who do not eat eggs.



AN ADEQUATE BALANCED DIET

FIGURE 7

(iv) The economic means of the group. Whatever the requirements, habit or customs of the group, the factor which is most important in the selection of foods is the amount of money available for purchasing food. This, in a family, depends upon the family income level, and in a hostel or institution, upon the total contribution to the food budget. Whenever the income level is low, quantity of food will always take preference over quality. This usually means that foods which supply heat and energy are bought in preference to foods necessary for growth and repair, and for regulation and protection, and the result is therefore malnutrition.

The balanced diet costs more than many people can afford, but some improvements in the present diet can be made, and nurses can do much to improve their own diet and to help others improve theirs. The use of parboiled rice instead of raw rice, substituting ragi and wheat for some of the rice will make it more balanced. Many green leafy vegetables are cheap. Sprouted gram may be substituted for the more expensive fruit sources of Vitamin C.

Ignorance and poverty are the main problems at the root of malnutrition and undernutrition and the whole question of adequate nutrition is therefore linked with the educational, social and economic status of a nation.

5. Diet in pregnancy and lactation

Pregnancy and lactation are normal conditions, which, however, make greater demands upon the body. The woman receiving an adequate diet during pregnancy is more likely to deliver an infant in good physical condition. While inadequate and improper diet may have a harmful effect on the growing foetus, repeated pregnancies will have a nutritional drain on the body of the poorly nourished woman, as nutrients required by the foetus but lacking in the diet are removed from maternal stores. Complications such as prematurity, congenital defects and stillbirths may occur. Toxaemia of pregnancy may also occur in the mother.

Weight of the infant at birth is a reflection of the weight gained by the woman during pregnancy. This weight gain should be 8-10 kg. Most of this should occur during the last trimester when the growth

of the foetus is most rapid. During the latter half of pregnancy calorie intake should be increased by 300 calories and protein by 14 gm. per day. Good quality protein, and calcium, phosphorous, iron and vitamins are all important in the diet of a pregnant woman. Milk is a good source of most of these nutrients.

Selection of foods during pregnancy

During the first three months of normal pregnancy the diet need not be different from the average normal diet for women. After the third month the foods should be selected in such a way that all essential nutrients are supplied in proper amounts. The following is a guide to show which foods should be included daily as well as a meal plan for one day.

15 gm sugar or jaggery

600 ml milk

120 gm meat, fish or 2 servings dhal

4 servings vegetables and greens

3 servings vegetables and greens

2 fruits and some nuts.

MEAL PLAN

Breakfast	Coffee (or tea) with 100 ml of milk
	Egg-1
	Cereal preparation, e.g. 2 iddlies
	Fruit-1
10 a.m.	Milk-100 ml
	Nuts-25 gm
Lunch	Rice-120 gm
	Mutton-60 gm (or alternative)

	Vegetables and greens
	Curds-100 ml
	Dhal sambar
3 p.m.	Milk-100 ml (in coffee or tea)
	Fruit-1
	Nuts-25 gm
7 P.m.	Roti-4
	Mutton-60 gm (or alternative)
	Vegetables and greens
9 p.m.	Milk-200 ml

A minimum of 15 gm of oil should be used in cooking per day.

Liver should be taken once or twice a week. For vegetarians, dhals and grams can be used in place of meat. An increased amount of milk must also be taken. When a family cannot afford to purchase large quantities of milk, groundnuts should be recommended. These can be used in preparing chutney. Green leafy vegetables, yellow vegetables, raw tomatoes, and citrus fruits such as limes, oranges and gooseberries must be included in the diet. Other fruits such as papaya and guava should also be included. Fried foods should be taken sparingly because they have a high calorie content and may cause excessive weight gain.

Selection of foods during lactation

Immediately after delivery the mother requires adequate rest for several hours. Normally, she will develop a good appertite during this period and can be given a normal or regular meal. Otherwise she can be given a light meal. In most cases, after 12 hours, the mother will have a normal appretite, and a regular diet should be given and continued. This will help to increase the secretion of milk. Spicy food should be avoided to prevent discomfort.

The nutritional demands of lactation are far greater than those of pregnancy. The requirements of calories, protein, calcium and vitamins

are increased. The I.C.M.R. laboratories recommend 2,700 calories per day with 110 gm of protein. Three-fourths of the protein must be from first class protein foods. The calcium requirement must be increased to 2 gm per day. A large amount of water must be taken to maintain the volume of milk and the fluid balance of the body.

The selection of foods during lactation is basically the same as that during pregnancy except for the daily addition of:

500 ml milk

30 gm mutton Or 15 gm dhal

fruit (preferably a citrus fruit)

QUESTIONS FOR STUDY

1) What is meant by a balanced diet?

2) Plan the day's food, non-vegetarian, for the following family, making certain that each member receives the special requirements for his or her age and special needs. Name definite foods and types of preparations.

   Father, hard work
   Mother, pregnant
   Boy, 15 years old
   Girl, 8 years old

3) Plan a vegetarian diet for the same family.

4) Plan a diet for the same family using only cheap foods.

5) What other factor besides meeting dietary requirements must be taken into consideration when planning a diet?

6) Estimate your own diet to see how it meets dietary require ments.

7) List all the foods available locally; classify them into the five food groups given on page **166**.

PART III

COOKERY

CHAPTER I

INTRODUCTION: PURPOSE AND METHOD OF COOKING

Meeting the nutritional needs of the patient has long been recognised as an essential function of nursing. An increasing emphasis however is being placed today on the fact that besides, medications and appropriate treatments, adequate nourishment has to be provided for the patient if he is to gain the full benefit of his treatment. In a country where a large number of the population are suffering from malnutrition in varying degrees, the nurse cannot help but be aware of her role in meeting this need.

In order to meet the nutritional needs of the patients effectively the nurse must have a working knowledge of the science of nutrition, an intelligent understanding of the principles of diet therapy and skill in the preparation and serving of foods. The first two factors are adequately discussed in their respective sections. This section is mainly concerned with the principles of cookery, recipes and suggestions for preparation of foods involved chiefly in invalid cookery.

The importance for the student nurse of a practical knowledge of cookery and of the learning of cooking skills is quite evident. Only a few of the large hospitals in India has special dietary departments and qualified dietitians. In most smaller hospitals the nurses are often called upon to assist in the selection, buying, cooking and serving of foods. In private nursing, the nurse frequently has to prepare foods with several modifications based on the dietary patterns of the individual patient. As a teacher of health, the nurse has to teach patients and their relatives both in homes and hospitals the simple rules of cookery. It is important, therefore, that the nursing student should have a basic understanding of, and certain degree of skill in the preparation of foods.

I. THE PURPOSE FOR COOKING FOOD

The purpose for cooking food and the effect of different methods of cooking upon food are important factors to be considered in all

food preparation, and particularly in the preparation of food for sick people and those who need to restrict one or more of the nutrients. Different methods of cooking are used in different types of diets. Food is cooked for the following reasons:

(i) To make the food more digestible:-

To soften and break down cellulose of plant foods and the connective tissue and fibres of animal foods and to make them more digestible.

(ii) To develop new flavours in food:-

To develop new flavours in food, either by the cooking method used, or by the addition of condiments, spices or other flavouring substances.

(iii) To make the food safe for human use:-

To destroy harmful bacteria and parasites so that the food is safe for human use. Destruction of bacteria also lengthens the time for which food can be kept if it cannot be eaten immediately. In the tropics it is not advisable to keep food of animal origin from one day to the next unless it contains some preservative or can be kept in a refrigerator.

II. METHODS OF COOKING

During the process of cooking, heat is applied to food in some way or other. The amount of heat and the form of heat depends upon the food to be cooked.

Methods which may be used are boiling, simmering, stewing, steaming, frying, grilling, baking and roasting. The majority of cooking in India is done over an open fire or some modifications of the same such as a chula (st e). Baking and roasting which need an oven are not so often used in the home or hospital.

Boiling. To boil food is to cook it in water which is maintained at a temperature of 100°C. For this, the water must be bubbling freely, but stea ly, all over the surface. Violent bubbling does not give any higher t perature, nor cook food more quickly, and it tends to break up the f placed in it, besides being a waste of fuel. The temperature may be regulated by varying the amount of firewood.

Boiling is satisfactory for cereals, pulses, dhals, and vegetables. It is not a good cooking method for meat and fish because it hardens the fibres of flesh foods.

Simmering is a modification of boiling. Food is cooked in water just under boiling point. The temperature should be about 84°C and this is indicated when an occasional bubble comes to the surface of the water, but if the bubbles rise continually the temperature is too high.

Simmering is useful for meat and fish because the temperature is high enough to coagulate the protein but not high enough to harden the fibres.

Poaching is similar to simmering, using water or other liquid in an open pan. This method is used particularly for eggs and fish.

Steaming is food cooked in the vapour which rises from boiling water. This may be done by placing the food container in a steamer above a pan of boiling water which comes only part way up the steamer's sides. It is a slower process than boiling, but flesh foods can be made very tender by this method. Care must be taken to see that the pan of water does not boil dry.

Stewing is to simmer food very slowly with only a little liquid in a covered pan on top of the stove. The addition of onions, tomatoes or diced root vegetables, and some condiments and herbs can make a meat stew very appetising.

Frying is cooking food in very hot fat or oil. It is one of the quickest methods of cooking and should be done in an open pan. The fat to be used for frying must be free from moisture and must have a high melting point so that it can be heated to a high temperature before it smokes and burns. Good frying oil is one that does not smoke at ordinary cooking temperature. To test if the oil is ready for frying, drop a piece of bread in oil. If it takes more than a minute to brown, the oil is too cold. For frying foods that have been pre-cooked, the pieces of bread should brown in half a minute.

For shallow frying, the fat in the pan needs to be only about 5 cm deep. The fat should be hot and quite smooth on the surface when

the food is put into it. When browned on one side, the food should be turned and browned on the other side. This method is satisfactory for fish cakes, cutlets and thin cuts of meat, fish and bacon.

For deep fat frying, a deep, heavy pan is needed. The pan should be not more than half full of fat. The fat should be heated until it stops bubbling, and is quite smooth, and has a faint blue smoke rising from the surface. The food should be lowered gently into the fat, and several pieces may be fried at one time. If too many pieces are put in together, the fat will get cool and will soak into the food and make it greasy or oily. When cooked, the food must be lifted out and the extra fat allowed to drain off. The food should not be greasy when served.

Baking is to cook food with hot air all round it. This method can be used for almost any food but particularly for bread, biscuits, cakes and pastry. An oven is needed for baking. This is really a metal box with a door on one side, which can be heated by placing it over a fire, or by oil, gas, or electricity. Food is placed on shelves inside and is cooked by the dry heat of the hot air inside the oven. The type of oven used for this method of cooking is not common in Indian homes, but when purchased an instruction book giving details for use is usually given. However a simple oven can be made from a kerosene tin. Live coals of fire placed on top of the tin help to make the heat inside the tin more even.

Roasting is similar to baking, but the food is placed in hot fat in a baking tin in the oven so that it cooks partly in the hot fat and partly in the hot air. This method is very good for cooking large joints of meat, and for root vegetables.

Grilling is cooking food by exposing it directly to very great heat either in front of a bright, hot fire or with a special grilling plate. Stoves heated by gas and electricity are usually fitted with plates, which can be heated for grilling. This method can be used for making toast and for cooking thin cuts of meat and fish.

QUESTIONS FOR STUDY

1) Give examples of foods, which are cooked for each of the three reasons mentioned. Are there some foods to which all three reasons apply?

2) Which method or methods of cooking may be used for each of the following: Meat, cereals, palaharams, fish, eggs, milk, cutlets, dhal. When several methods are be used what are the advantages of each?

3) What kind of oil is best for deep-frying? How can you tell that the oil is at the right temperature?

CHAPTER 2

EFFECT OF HEAT AND COOKING ON FOODS

I. THE EFFECT OF HEAT ON THE NUTRIENTS IN FOODS

To understand the way in which cooking affects the digestibility of food, it is necessary to know the effect of heat upon the main nutrients.

1) Carbohydrates

Of the carbohydrates in food, starch is the most affected by heat. If water is used in cooking, the starch grains absorb water swell and eventually rupture the cellulose walls of the cells. The starch is then said to be gelatinised.

Dry heat converts starch into a soluble form, and eventually into dextrin. This is responsible for the brown colour and slightly sweet taste of baked cereal foods, e.g., the crust of bread.

Cellulose is not digested in man, but must be broken down in order for the cell contents to be digested. Cooking softens the cellulose, but it is the swelling of the starch grains inside, which is largely responsible for breaking the cellulose.

2) Proteins

The effect of heat on proteins is to coagulate them. This takes place at a temperature of about 60oC. Above that temperature the protein of most animal foods, with the exception of eggs, shrinks and becomes slightly less digestible. Vegetable proteins also coagulate on cooking, but they are usually found along with starch, which swells in moist heat and bursts the cellulose covering. Cooking thus makes vegetable protein more digestible.

3) Fat

Fat is not affected by heat so much as protein and carbohydrate. As it is heated, fat melts, but at high temperatures it begins to decompose and may be irritating to the stomach.

4) Minerals

Minerals are little affected by cooking, but may be lost by solubility in water.

5) Vitamins

Vitamins vary in their stability in cooking. This has been dealt with in detail under the individual vitamins, but may be summarised briefly:

Vitamins A and D and Nicotinic Acid are little affected by the process followed while cooking at home.

Thiamine, Riboflavin and Vitamin K are destroyed in the presence of alkali, e.g., soda bicarbonate, and may also be lost by solubility in water.

Vitamin C is the most unstable of the known vitamins and can be easily lost or destroyed in food preparation.

II. THE EFFECT OF COOKING ON DIFFERENT TYPES OF FOOD

1) Cereals

Cereals consist mainly of starch with a little protein enclosed with a cell wall of cellulose. The cooking method used must be adequate to break the cellulose so that the digestive juices can reach the starch.

Boiling of cereals causes the starch grain to swell and burst the cellulose. Rice, for example, absorbs twice its own weight of water during cooking, and the cooked weight is therefore three times the dry weight.

If much water is used in cooking cereals, the thiamine will be lost from food by solubility in water. Thiamine will be destroyed if soda bicarbonate is added during the cooking.

The protein of cereals is also coagulated on cooking and depends on the breaking of the cellulose for digestion.

Well-cooked cereals are thus more easily digestible than cereals in the raw state.

2) Pulses

Pulses contain less carbohydrate but more protein than cereals but the effect of cooking is much the same. Pulses also contain some carbohydrate which is not digestible and an antitrypsin substance which prevents the action of trypsin. The undigested carbohydrate may be broken down by bacteria in the large intestine causing flatulence. The antitrypsin substance is destroyed by adequate boiling so that it is very important that pulses and dhals should be properly cooked.

3) Green leafy vegetables

Green leafy vegetables provide little calorie value but give much of the mineral and vitamin content of normal diet. They are usually cooked by boiling but there is almost invariably some loss of food value in the process. If much water is used, some of the minerals, thiamine and Vitamin C will be lost by solubility. Thiamine may also be destroyed if soda bicarbonate is used in the cooking. Reference should be made to the section on Vitamin C in part II **'Nutrition'** for ways in which this vitamin may be lost in food preparation and methods which should be used to conserve the food value. Vitamin A and carotene content is not much affected by home methods of cookery.

4) Other vegetables

Other vegetables vary in food content but, like green leafy vegetables, contribute minerals and vitamins to the diet. The same precautions should be used in preparation and cooking to preserve the food value.

Tubers, e.g., potato and yam, contain a higher proportion of starch than other vegetables and must be adequately cooked so that the starch grains swell and burst the cell walls. They should not be soaked in water for a long time unless they are old. Nutrients in tubers are retained by cooking with the skin but if they are old, the strong flavour is retained also. New potatoes and carrots should be scraped rather than peeled to preserve the mineral layer. It is preferable to bake, steam or boil the tubers slowly as rapid boiling breaks the skin.

5) Fruits

With the exception of fruits which are good sources of Vitamin C, e.g., citrus fruits, gauva and nellikai (amla), fruits are eaten more for their sweetness and flavours than for their nutritive value. Fruits consist of 85-90 percent water with a little carbohydrate as cellulose and sugar. The protein, fat and mineral content is very low.

The majority of fruits can be eaten raw, and if fresh will supply Vitamin C to the body. Cooking makes fruit more digestible as it softens the cellulose but this usually results in the loss of sugar by solubility in water. If the fruit is stewed and the juice eaten along with it, the sugar loss is very little but there will still be loss of Vitamin C.

6) Meat, fish and liver

These are all protein foods of animal origin, which contain also variable amounts of fat.

When meat is cooked, there is a reduction in the water content, and this occurs even when the meat is boiled. There is also coagulation of the protein, softening of the fibres by conversion of the connective tissue to gelatine, and the fat melts. If meat is cooked by roasting or grilling, the protein on the surface coagulates quickly, sealing the juices inside the meat.

Some of the mineral salts may be lost in the process of boiling or stewing, but this is of little importance if the liquid is also used as soup or gravy.

Prolonged cooking, especially by dry heat as in roasting, causes the protein to become hard and indigestible.

There are three main kinds of fish:

(i) White fish, with flesh, which is opaque and white when cooked, containing protein but very little fat. it is regarded as the most easily digestible kind of fish.

(ii) Oily fish, with flesh which is a pinkish-brown colour when cooked,contains a higher proportion of fat than white fish, and as a result, is less easily digestible.

dense and tough and difficult to digest.

The cooking of fish improves the digestibility in the same way as meat. Fish has, on the whole, less flavour than meat, but can be made very tasty by serving an appetising sauce with it.

Liver and kidney are compact organs containing mainly proteins with very little fat or connective tissue. Because of their close texture they are rather difficult to digest unless well-cooked and finely chopped or carefully chewed.

7) Milk

Milk is often termed a perfect food, but this is not strictly true because it lacks two essential nutrients, iron and Vitamin C. milk is, however, one of the most easily digestible and nutritious foods.

Boiling of milk causes little change in the food value, though it brings about some change in taste. If the milk is kept at boiling point for some time, to sterilize it, then the taste is quite changed, and there may be some loss of vitamin content. Pasteurization does not alter or change the taste and vitamin content much.

When milk is taken, it curdles as soon as it reaches the stomach, due to the action of rennin. Boiled milk curdles more slowly and gives a less dense clot than raw milk, and is more easy to digest.

Milk drunk rapidly produces smaller curds and is more easily digestible than milk drunk slowly or sipped. Milk mixed with some other food, particularly if cooked with cereal, is more easily digestible than plain milk because the starch helps to break up the curds.

Citric acid or sodium citrate added to the milk precipitates some of the calcium and produces a less dense and more easily digestible clot. Sodium citrate added in the proportion of 1 grain per 30 ml. of milk does not alter the taste, but increases the digestibility.

8) Eggs

Eggs contain protein, which coagulates on heating. Raw eggs are not well digested unless beaten or mixed with other food but the digestibility of cooked eggs depends on the method of cooking.

Lightly boiled, poached, or scrambled eggs are the most easily digestible. If fried, or made into omlette, the extra fat used in cooking decreases the digestibility of the egg.

If an egg is to be cooked until both the white and yolk are solid, it should be kept in water at about 78°C for 10-15 minutes but not allowed to boil. Hard-boiling makes the protein dense and leathery and difficult to digest.

Except for modifying the digestibility of the protein, there is little change in the nutritive value of eggs on cooking. There may be some loss of thiamine.

QUESTIONS FOR STUDY

1) What is the difference in the effect of moist and dry heat on starch?
2) Which foods are likely to lose valuable nutrients if boiled in much water?
3) Which foods become more digestible by cooking? Which become less digestible?
4) Milk and eggs are often used in diets for sick patients. How can these be prepared so they will be most easily digestible?

CHAPTER 3

RECIPES AND KITCHEN EQUIPMENT

The following equipment should be available for preparation of invalid diets.

Kitchen scales for weighing

Measuring cup, litre measures

Mixing bowls, 2 sizes

Strainers (metal and wire) or a clean piece of gauze or muslin

Knives, various size	vegetable knife Chopping knife Kitchen knife Bread knife
Spoons, various sizes	tablespoons Dessert spoons Teaspoons Set of standard measuring spoons Wooden spoons, 2 sizes

Fork

Egg whisk or beater

Lemon squeezer

Grater

Wooden board for chopping and rolling

Rolling pin

Saucepans, various sizes, including double saucepan or double boiler and steamer

Meat mincer or grinder

The additional minimum equipment for cleaning and handling utensils and stoves would be:

Thick padded cloth for handling hot pans

Towels for drying dishes

Dish cloth

Mop or floor cloth

Scouring brush or coconut fibre

Refuse bin or drum with lid.

INSTRUCRTIONS FOR MEASURING

In order to get the best results it is essential to measure accurately all the ingredients, or substances, which go into any food prepared.

All measurements in recipes are level. Dry substances in a cup or spoon should be levelled off with the straight edge of a knife.

Solid fats should be packed into the cup or spoon and levelled off with a knife. If part of a cup of fat is desired, such as ½ cup, partly fill the cup with water leaving room for the desired amount of fat, in this case fill with ¾ cup of cold water and add enough fat to fill the cup. Then pour off all the water.

All teaspoons are not standard size, nor are all tablespoons. It is more accurate, therefore, to have standard measuring spoons or to compare measurements of available spoons with standard size, as for example comparing with measurements in a marked medicine glass. If a half-teaspoon measure is required, fill teaspoon, level off, and cut in half lengthwise, removing one half.

RECIPES

The majority of cookery books have a section on recipes for invalid cookery, but the following may be taken as basic recipes for preparation of light and easily digestible foods. The recipes are divided into the following groups.

I. Clear fluids

II. Full fluid diet recipes

III. Light cereal preparations

IV. Vegetable preparations

V. Egg recipes

VI. Fish and meat recipes

VII. Light puddings

CLEAR FLUIDS

Clear tea

Have water ready for boiling. Do not use water, which has been boiling for some time as it spoils the flavour. When the water starts to boil pour a little into the teapot to warm it. Empty out this water and put the tea into the teapot (one teaspoon of tea for each person). Pour the boiling water over the tea and allow to stand for 3 to 5 minutes. Strain and pour. Dilute with hot water if desired and add a few drops of lime or lemon juice and sugar to taste.

Black coffee

One heaped tablespoon of pure coffee powder.

Freshly boiled water, 300 ml.

Heat the coffee jug thoroughly. Put the coffee in the jug, pour in the boiling water and allow to stand near the fire for 10 minutes. Strain and serve as black coffee with sugar if desired.

Clear soups

The basis of clear soups is meat stock.

To make stock allow two pints of water to each pound of bones or meat. Chop the bones and cut up the meat, then put into cold water and bring to simmering point. If a little salt is added it helps the scum to rise. Simmer the stock for a minimum of 2-3 hours, removing

the scum as it rises. Allow cooling thoroughly. Strain through fine muslin to remove the fat and solid matter.

The stock may be used as it is for soup, or simmered again with diced vegetables to add other flavours. Strain and serve very hot.

Fruit juice

Fruit juice may be prepared from fresh fruit, or by dilution of commercially prepared fruit squashes. Remove the juice from citrus fruit by means of a squeezer, strain, dilute with water and add sugar or glucose to taste.

Fruits which stew well, e.g., apples, tomatoes, may be stewed with a little water until pulpy, then strained through muslin. Add water and sugar or glucose to taste.

Raw tomato juice

Select ripe, juicy tomatoes. Pour boiling water over the tomatoes and let stand for 2 minutes to loosen the skin. Remove skin. Mash the tomatoes and press through a strainer as much of the juice and soft part as possible. Add salt and pepper to taste. Some may prefer sugar.

Whey

To 500 ml of fresh milk warmed to blood heat (37°C) add one to two teaspoons of rennet. Set it aside in a warm place for a quarter of an hour. Then break up the curd thoroughly by stirring with a fork. Let it stand for 15 minutes, then strain the whey through muslin and bring it to the boiling point. Curds (perugu) may be used in place of rennet.

Lime whey

To 500 ml of fresh milk add four tablespoons of lime juice. Boil without stirring until the curd separates. Strain through several thickness of gauze and add sugar. Cool and serve.

Barley water (1)

1 tablespoon of barley flour

500 ml of boiling water

2 tablespoons of cold water

Salt

Mix the flour to a smooth paste with cold water, and gradually add the boiling water, stirring all the time; boil about 30 minutes; add salt and (if permitted) one tablespoon of lime juice, and strain before use.

Barley water (2)

30 gm of pearl barley

500 ml of cold water

Blanch the barley by covering with cold water. Simmer the barley slowly with 500 ml of water till it is reduced to approximately 300 ml (about 1 ½ hours), and strain. A fresh supply should be made at least twice daily. Lime juice may be added to the water before boiling if desired, and sugar added to taste.

Albumin water (1)

Press the whites of two eggs through gauze into a glass, and without beating add lime juice, water and sugar.

Unsweetened albumin water added to beef juice, or to the beverage, gives that beverage a decidedly nutritious value. It is especially useful in pyrexia.

Albumin water (2)

Take the whites of two fresh eggs. Add one cup of water. Put into wide necked bottle. Cork it and shake thoroughly. Add a little lime juice and sugar. If preferred orange juice may be substituted for the lime juice.

FULL FLUID DIET RECIPES

Tea and coffee

Tea and coffee should be prepared as for clear fluids and served hot with the addition of milk or cream and sugar or glucose to taste.

Cocoa

1 teaspoon cocoa

1 cup of milk

Sugar

Mix the cocoa with a very little milk. Boil the remainder of the mild and pour over the mixture, stirring constantly. Add sugar to taste. If desired, half milk and half water may be used, and the cocoa boiled after adding the milk.

Fortified milk

60 gm milk powder (skimmed or whole)

60 ml fresh milk

Mix the milk powder with a little cold milk then add the remainders of the milk, beating thoroughly to ensure complete mixing.

This milk may be used when additional food value is required without additional volume. It may be used for all preparation where milk is commonly used.

Egg flips or egg nog

Beat an egg thoroughly (yolks not used in albumin water may be used) and add 250 ml of milk. Stir well and strain before serving. This may be flavoured with sugar, cinnamon or lemon juice. If desired, it may be added to coffee, tea or cocoa.

Dhal soup

½ cup of dhal

2 cups of water

1 large onion

Salt

Grind the dhal finely, chop and fry the onion, mix all the ingredients and boil for 20-30 minutes.

Vegetable soup

¼ cup diced vegetables

2 cups of meat stock

small pat butter (about 1 teaspoon)

salt and pepper.

Prepare and dice the vegetables. Place in saucepan and saute in melted butter for a few minutes. Add the boiling stock, salt and pepper to taste and boil gently until the vegetables are tender. Mix 15 gm flour with a little cold stock, add to the boiling stock, stirring continually, and boil until the soup is thickened. If desired, the vegetables may be rubbed through a strainer before thickening the soup.

Cream of Vegetable soup

Vegetables are cooked and mashed or forced through a strainer to make pulp, and combined with milk and the stock in which the vegetables were cooked. In order to have the vegetable pulp uniformly mixed through the liquid it is necessary to thicken with a starchy material (flour with butter, mixed and cooked as a white sauce). So cream soups are simply white sauce to which vegetable pulp is added.

General proportions

1 part vegetable pulp or puree

To 2 parts liquid (milk, vegetable stock or meat stock) 1 tablespoon flour is used. The proportion of flour to liquid is ½ tablespoon flour to 1 cup liquid if starchy vegetable having little thickening property is used.

Different kinds of vegetables are sometimes mixed for soup or vegetables and meat stock are mixed.

Butter milk

1 cup curds

1 cup water

Add ¼ cup water to the curds and whisk or beat, removing the fat if necessary. Add the remainder of the water and mix. Less, or more water may be added as desired. If required, a little seasoned oil may be added.

LIGHT CEREAL PREPARATION

Double boiled rice

2 tablespoons of rice

Pinch of salt

240 ml of milk, water or milk and water mixed.

Wash the rice and add it to the milk. Simmer gently for 1 to 1 ½ hours, till it is reduced to a pulpy mass. Add sugar if desired before serving. Cooking in a double boiler is more easily regulated than in an ordinary saucepan.

Ragi conjee

Ragi, after being ground, should be sifted two or three times through muslin. One tablespoon of the ragi flour should be mixed till smooth with a little cold water. Then gradually add 300 ml of boiling water with a pinch of salt and boil for 15 minutes. If preferred half milk and half water may be used.

Arrowroot conjee

2 teaspoons of arrowroot

125 ml of boiling water

Sugar to taste

1 tablespoon of cold water

125 ml of hot milk

A pinch of slat

Mix the arrowroot to a smooth paste with the cold water and add the boiling water gradually. Boil for 10 minutes, stirring constantly. Then add milk and salt and boil for 10 minutes more. Add sugar if desired before serving.

Barley conjee

1 tablespoon of prepared barley flour

2 tablespoons of cold water

¼ teaspoon of salt

125 ml of warm milk

125 ml of boiling water

Mix barley flour to a smooth paste with the cold water, add the boiling water gradually, stirring constantly, and boil for 30 minutes. Add milk and salt, and bring to the boiling point.

Toast

Cut bread thinly and dry both sides by holding on a fork before a fire, or placing under grill for a few minutes. Then toast both sides until golden brown. Cut into neat pieces, and serve hot and crisp.

Rusks

Cut thin bread into slices, and cut the slices into convenient sizes, or fancy shapes. Lay on a baking tray and bake in a cool oven until crisp, lightly brown and slightly curled. Rusks should be served hot, but may be stored in an airtight tin and reheated before serving.

VEGETABLE PREPARATIONS

Pureed vegetables

Select tender vegetables one or more kinds, wash and cut into pieces. Cook by boiling or steaming until soft. Strain off the water and use for soup or sauce. Rub the vegetables through a strainer or

sieve with a wooden spoon, collect the pulp. Add salt and pepper or a little seasoning to taste, and reheat before serving.

White sauce

30 gm flour

30 gm fat

300 ml liquid (milk or milk and water, or milk and stock)

Melt the fat, stirring in the flour as it melts. Mix well and cook gently for two minutes for a white sauce or until brown for a brown sauce. Remove the pan from the fire and add the hot liquid, stirring all the time. Boil for five minutes, stirring all the time; and seasonings and flavourings to taste.

It is important to see that the fat and flour are well cooked and smooth before adding the liquid.

For creamed vegetables, choose tender vegetables, wash and cut into dices. Boil or steam until soft, and strain off any liquid. Mix the cooked vegetables with enough of a white sauce to coat the vegetables thoroughly, and serve very hot.

EGG RECIPES

Soft cooked egg

(a) Lower the egg gently with a spoon into a saucepan of boiling water deep enough to covei it. Put the lid on the pan and allow to stand for 4-5 minutes. Serve immediately after the egg is removed from the hot water.The water should not be allowed to boil after putting in the egg.

(b) Place egg in cold water and bring to a boil. Let it boil for about ½ minute. Remove with spoon.

Hard boiled egg

Lower the egg into hot water and keep at simmering temperature for 10-15 minutes according to the size of the egg, and how hard it is required. If the egg is to be used cold, it should be cooled immediately

after cooking by placing in cold water. The shell may then be removed easily.

Poached egg

Use a small pan with water coming about two-third up the pan. Add a level teaspoon of salt and a teaspoon of vinegar to each 500 ml of water used. This helps to set the egg. Bring the water almost to boiling point. Break the egg into a cup, taking care to keep it whole, and slide it gently into the water. Tilt the pan, and with a tablespoon gently gather the white round the yolk.

Simmer until the white is nicely set, (about three minutes), lift out the egg carefully, draining off the water and serve on hot buttered toast.

Scrambled or buttered egg

Beat the egg well, adding salt and pepper and a tablespoon of milk. Melt just enough butter in a saucepan to cover the bottom of the pan. Put in the egg and cook slowly over a very gentle heat, stirring lightly to prevent Beat the egg well, adding salt and pepper and a tablespoon of milk. Melt just enough butter in a saucepan to cover the bottom of the pan. Put in the egg and cook slowly over a very gentle heat, stirring lightly to prevent the egg from sticking to the pan. The egg should be soft and creamy when cooked and should be served immediately.

Omelette

Use a perfectly clean, smooth, flat frying pan. Beat two eggs lightly, just enough to mix the whites and yolks and season with salt and pepper. Heat just enough butter to cover the bottom of the pan, and when very hot, pour in the eggs and cook quickly, stirring gently with a knife. As the egg sets, tilt the pan slightly to allow the uncooked egg to run down on to the hot pan. As soon as all the egg is set, roll the omlette over, turning in the edges, and roll on to a very hot plate. Serve immediately.

If the omlette is to be filled, add the hot cooked filling, e.g., minced meat, chopped tomato, just before the omelette is rolled over.

FISH AND MEAT RECIPES

Steamed fish

Clean the piece of fish and drain free from water carefully Sprinkle a little pepper and salt on the fish, fold in two, lay on a buttered plate and cover with buttered paper and a lid. Place the plate over a pan of boiling water and steam for 15-20 minutes or until the fish looks quite white, and the flakes separate easily. Serve on a hot dish with the juice poured over it. A small piece of lime or lemon may be served with the fish.

Creamed fish

Prepare a white sauce as given for creamed vegetables. Prepare and steam four ounces of fish as for steamed fish. When the fish is cooked, remove from the bone, if any, and break up finely. Mix with enough sauce to coat well, and pound thoroughly. If desired the mixture may be rubbed through a sieve. Add the stiffy beaten white of one egg, turn into a greased tin or mould, cover with greased paper and steam until firm.

Creamed chicken

Creamed chicken may be prepared as for creamed fish, but the meat must be finally minced before pounding.

Mince

250 gm cooked meat

150 ml heated stock

pepper and salt

small pieces of fried bread

Remove the fat and skin from the meat and chop or mince finely. Put into a pan with the heated stock, salt and pepper or other seasonings, and reheat thoroughly. Do not re-cook. Serve decorated with fried bread.

Minced liver

250 gm minced liver

1 onion

100 ml water

Cut the onion into rings, and fry in a little hot fat. Add the minced liver and fry very lightly. Add seasonings and the water and bring to the boil. Serve hot.

LIGHT PUDDINGS

Fruit jelly

500 ml fruit juice

100 gm sugar

20 gm powdered gelatine

Put all ingredients into a pan and warm gently, stirring all the time. Turn into a rinsed mould and allow to set, preferably in a refrigerator. Keep cold until served.

Milk jelly

500 ml milk

50 gm sugar

strip of lime or orange peel

15 gm powdered gelatine

Put the lime or orange peel in the milk. Bring to boiling point and strain the milk on to the gelatine and sugar, stirring until all is dissolved. Keep in the basin, stirring from time to time until the mixture is the consistency of thick cream. Pour into rinsed moulds and allow to set.

Baked custard

1 egg

180 ml milk

Sugar to taste

Beat the egg lightly, heat the milk and pour on to the egg, stirring all the time. Add sugar to taste and stir well. Pour the mixture into a greased dish and spinkle a little grated nutmeg on top of desired. Stand the dish in a baking tin with hot water halfway up its sides. Bake in a moderate oven until set.

If steamed custard is required, pour the mixture into individual greased moulds, place in a steamer and simmer until set.

Cornflour Pudding

500 ml milk

Thin strip lime or orange peel,

Or other flavouring

30 gm sugar

15 gm custard powder

30 gm cornflour.

Pour about three-quarters of the milk into a saucepan, add the orange rind or other flavouring, sugar and a pinch of salt and bring to the boil slowly. Mix the cornflour and custard powder together with the remaining cold milk. Pour the boiling milk into the mixed custard and cornflour, stirring well. Return to the pan and boil for a few minutes until it thickens. Pour into individual moulds and allow to set until cold.

Mango snow

750 gm green mangoes

Small amount of water

200 gm sugar

Juice of 1 lime

3 cloves (opitional)

Whites of two eggs.

Peel the mangoes and cut into small pieces. Put into a pan with a very small amount of water, the sugar, and cloves and a piece of lime peel if desired. Stew until tender. When ready strain and beat with a fork into a smooth pulp. Add the lime juice. Beat the egg whites stiffly and add the cooked mango pulp slowly, beating well. Pile the mixture into individual dishes to serve.

Ice-cream

Milk 250 ml

1 egg

Sugar 20 gm

Flavouring

Beat the egg lightly and mix in the milk and sugar. Heat over a low flame or in a double boiler until the mixture begins to thicken. Remove from the heat and cool quickly. Flavour as desired and freeze.

PART IV

DIET THERAPY

CHAPTER I

PRINCIPLES OF DIET THERAPY

The general principles of nutrition relating to health apply also to the treatment of patients suffering from various diseases. Diet in disease must be planned as part of the complete care of the patient. Many modifications may have to be made according to the disease and the condition of the patient, but there are certain general principles, which may be used for guidance.

GENERAL RULES FOR TREATMENT

1) The diet must be planned in relation to changes in metabolism occurring as a result of the disease. This may make it necessary for the patient to change his diet habits, reducing amounts of some foods, and increasing amounts of other foods.

2) The diet must be planned to agree as nearly as possible with the patient's food habits, his likes and dislikes, how food agrees with him, and the amount of exercise he takes.

3) Adequate explanation must be given when it is necessary to make dietary changes quickly. Foods which are to be forbidden should be stated clearly, but a food should not be forbidden unless there is a good reason. Otherwise, changes should be made gradually.

4) In a short, sharp illness, appetite often fails and food should not be forced, but in a long illness, wasting must be prevented by providing adequate amounts of food to replace lost tissue.

5) Whatever the diet prescribed, there should be plenty of variety; hot foods should be served hot, and cold foods cold.

I. TEAM APPROACH TO NUTRITIONAL CARE

Meeting the patient's nutritional needs involves the co-ordination of several hospital departments. The care team is composed of the physician, nurse and dietitian. The physician prescribes the diet. The dietitian is the specialist who translates the physician's written order

into practicality in terms of foods. The dietitian assesses and evaluates the patient's nutritional status, formulates nutritional care plans, designs meal patterns, according to the patient's food habits and modified according to the therapeutic need and advises on therapeutic nutritional effects and subsequent counselling.

The nurse is the member of the health team who has the most constant and intimate association with the patient and the direct services she or he gives to the patient differ from those of the physician or the dietitian. Some specific means by which nursing personnel assist in nutritional care include the following:

1. Maintaining lines of communication between the physician and dietitian regarding the patient's needs.

a. Obtaining a diet prescription if there is more and arranging for food service to the patient.

b. Providing the dietitian and physician with information regarding the patient's response to the diet.

c. Serving as liason between the patient and the physician and dietitian.

2. Assisting the patient at meal times.

a. Providing conducive environment to eating.

b. Preparing the patient for meal.

c. Giving assistance to the patient as needed, including feeding.

d. Helping the handicapped to adjust to self feeding.

e. Giving encouragement and support to the patient.

3. Interpreting the diet to the patient.

a. Explaining the reasons for a modified diet and what may be expected of the diet.

b. Answering the questions about the diet.

c. Observing, recording and reporting the patient's response to diet.

d. Eliciting information regarding food habits, likes and dislikes and attitude toward diet.

e. Noting adequacy of food mistake.

f. Reporting patient's response to dietitian and physician.

4. Planning for home care.

a. Identifying needs for outside assistance.

b. Arranging for counseling regarding home diet with member of family as well as patient.

FACTORS TO CONSIDER IN THE STUDY OF DIET THERAPY

1) Acute and chronic conditions which require a change in diet.

2) The retinal for dietary changes. Characteristics of diet, its beneficial and possible adverse effects, nutritional limitations of the various modified diets and indications and contraindication for use.

3) Ways in which drug therapy may influence food intake or utilization

4) The patients tolerance for food.

5) Understanding of the phychologic and emotional factors influencing food acceptance.

6) Social, cultural and religious patterns

7) Availability of foods, cost of foods, suitable methods of food preparation.

II. MODIFICATIONS OF NUTRIENTS IN THERAPEUTIC DIETS

Modifications of quantities of some of the nutrients may be necessary, but the following points should be noted.

1) Carbohydrates. They are usually well tolerated and are necessary to maintain the store of liver glycogen. Sugars and well-cooked starches are easily digested and absorbed, and are not held for long in the intestine.

2) Fats. The tolerance of fats varies in different individuals and this nutrient should not be forced if there is nausea and vomiting. At times, the fat used may be the patient's own body fat. During diseased conditions, if food taken by the patient is not adequate for the body needs, then the fat stored in the adipose tissue will be used for energy. Fatty acids coming from these fats are broken down to ketone bodies in the liver. The ketone bodies are then sent to the peripheral tissues for completion of oxidation to carbondioxide and water. In the absence of carbohydrate, ketone bodies are produced more rapidly in the liver than they can be oxidized in the tissues, and so they accumulate in the blood, resulting in the condition known as ketosis.

3) Protein. In illness, there is usually an increased demand for protein due to wasting, and this should be given in easily digestible forms such as milk, eggs, chicken and fish. However, if the level of urea in the blood is greater than normal, the amount of protein in the diet must be restricted.

4) Inorganic elements. The requirements of calcium and iron must be maintained during illness and it is therefore necessary to check these elements if a patient is on a restricted diet for a long time. Sodium and potassium may sometimes needed to be restricted, especially if there is oedema and ascites.

5) *Vitamins.* Vitamins must always be adequate to maintain the balance of a diet. Fat-soluble vitamins often need to be added as concentrates if a patient has to be on a fat-restricted diet for a long time. Vitamins of the B Complex are often deficient in Indian diets and may not be adequately absorbed in pathological conditions of the gastro-intestinal tract. The demand for Vitamin C is greatly increased in fevers, and it is especially necessary for the healing of wounds after surgery.

6) Roughage. Excessive bulk hinders the penetration of the digestive juices, but it may be necessary to include foods with a moderately high residue content to produce daily bowel action.

7) Fluids. These are very important to prevent dehydration, which is common in conditions of fevers, diarrhoea or vomiting. In such

conditions, 2,500-3,000 ml must be given in 24 hours with as much variety as possible, both in appearance and in taste. If adequate fluids cannot be given by mouth, they must be given intravenously. Fluids with added protein are necessary for patients who must be fed on liquid diets for a long time.

In almost all diseases, milk is one of the best foods, except for its deficiency in iron, thiamine and ascorbic acid, but it must be modified and flavoured in different ways to prevent monotony.

III. TYPES OF DIETS USED IN HOSPITALS

Therapeutic nutrition should begin with the normal diet. The types of diets usually available for patients in hospitals are:

i. Regular or full diet, vegetarian or non-vegetarian, which should be well-balanced and adequate for normal nutrition. This is for patients who do not need any special modifications.

ii. Soft or light diet, which is the step between the full liquid and the regular diet.

iii. Liquid diet for those unable to take solid food.

iv. Modified diet for those requiring modifications of the regular diet in order to supply various needs of the body in disease.

Modifications of the regular diet may be made by:

a) Changing the methods of preparation, e.g., soft diet.

b) Changing the consistency, e.g., liquid diet.

c) Increasing or decreasing the total amounts of energy (calories).

d) Adding or reducing one or more nutrients, e.g., high protein, low sodium.

e) Increasing or decreasing bulk, e.g., high or low fibre diets.

f) Including or excluding specific foods, e.g., for allergy conditions.

Regular or full Diet

See discussion of normal balanced diet in Chapter 9, Part II, **Nutrition**, Page 170.

Soft or Light Diet

This diet is the usual dietary step between the full liquid and the regular diet. The chief difference between this diet and the regular diet is the method of preparation. The foods are cooked more simply with less spices and are more easily digestible and lower in roughage.

Some patients may require foods that need little chewing but they may be able to eat normally prepared food, which has been well minced or mashed. This type of diet is called a 'mechanical soft' diet.

The soft diet is nutritionally adequate when planned on the basis of the regular diet.

Liquid Diet

Liquid diets are used for patients who are unable to tolerate solid food. This is a modification of the consistency of a regular diet. Foods, which are liquid or liquefy at room temperature, are used in liquid diets. If a liquid diet has to be used only for a short time, the patient will soon receive any deficiency of Calories or nutrients when he is given normal food. However, if the patient must be fed with liquids for a long time, it is most essential to see that the diet should be adequate in all respects. For this purpose, iron and many of the vitamins may have to be supplied as concentrates.

A liquid diet may be either a clear liquid or a full liquid diet.

The clear liquid diet is used when an acute illness or surgical procedure produces a marked intolerance to food and it is advisable to restrict the intake of nutrients. The only foods permitted on this diet are clear tea, weak black coffee, fat-free broth, clear soup, meat and yeast extracts, soda water and other aerated beverages, clear fruit juice, barley-water, gelatine (in jelly), sugar and glucose. Such fluids have practically no food value other than calories. The calories may be increased by the use of glucose. This diet is usually continued for only one or two days.

The full liquid diet is given when the total nutrition of the patient must be maintained by fluids for a long period of time. This is necessary when the patient is unable to swallow solid food or if the patient

must be fed by intra-gastric or gastrostomy tubes.

The diet includes all liquid foods at room temperature and at body temperature. It should be free from cellulose and irritating condiments. Milk usually forms the basis of such diets because it provides adequate protein and calcium.

When giving a full liquid diet, six or more feedings must be given daily. The protein content of the diet can be increased by adding whole egg, or skimmed milk powder. Meat and liver may be added to broth or soup. The calorie value of the diet may be increased by:

a) adding cream to milk

b) adding butter or oil to the cereal gruel (conjee) and soup

c) including glucose or lactose or corn syrup in beverages (these are expensive but less sweet and can be used in larger quantities than sugar)

d) using ice-cream.

If a decreased volume of fluid is desired, skimmed milk powder can be given instead of part of the fluid milk. If protein must be restricted, starches such as arrowroot, sago and cornflour can be used to increase the calories.

When the patient cannot tolerate food by mouth, feeding can be done through a tube.

The liquids, which can pass through the tube will provide adequate nourishment.

TABLE OF FOODS ALLOWED ON REGULAR, LIGHT AND LIQUID DIET

TYPE OF FOOD	REGULAR	LIGHT	LIQUID
Diary product	All curds, cream, butter, ghee	Milk, butter milk, cream, ice-cream	Milk, curds,
Eggs	All	Soft cooked	Egg flip
Meats	All liver, ground meats	Tender chicken soup	Blended with

Fish	All not fried	Soft preparation ...	
Soup, Broth	All	Strained	Same as light
Dhals, pulses	All mashed dhals no wholegrains	Well cooked and	
Cereals	All samia, macaroni, sago, iddly, puttu iddiappam, packet cereals (not whole grain)	Double boiled rice, liquefied gruels or strained conjees	Strained or
Bread	All	All	
Vegetables	All + salads	Well cooked and salads	Liquefied in soft soups
Fruits	All ,juices, citrus fruits (no fibres or seeds), plantains.	Cooked or canned juice	Strained fruit
Puddings	All jelly, plain cakes and biscutes	Ice-cream, custard, custard	Ice-cream, jelly,
Beverages	All	Tea, coffee, cocoa, milk beverages, carbonated drinks	Same as light

The gastrostomy feeding may be planned as for a full liquid diet. Using milk as the basis, eggs, milk powder, sugar, butter, oil and fruit juices may be added. Cereal gruels which will pass through the tube easily should also be included. If refrigeration is available, feedings for 24 hours may be prepared and used as required. When this is not possible each feeding should be mixed separately.

The *jejunostomy* feeding is described on page 234.

IV. MANAGEMENT OF SPECIAL DIETS

1) Consideration of the patient's food habits

When a special diet is ordered by a doctor, the management of that diet is as important as any other part of a patient's treatment. It must be carefully noted what type of diet it is and whether there are any restrictions or additions needed, e.g., fat, protein, carbohydrate, salt.

The patient must then be questioned on his food habits as follows:

a) Is the patient a non-vegetarian or vegetarian?

b) If non-vegetarian, does the patient take all such foods? E.g., mutton, fish, liver, eggs, beef, pork.

c) If vegetarian, does the patient take eggs ?

d) What type of cereal is taken by the patient for breakfast, lunch and dinner? E.g., conjee, bread, rice (parboiled or raw) chappathi, wheat, rice. What other preparations are common inthe patient's community.

e) Does the patient take coffee, or tea, or both, and at what times?

f) How much milk does the patient normally take, and can this be increased if necessary? Is it taken plain, or with sugar or with some other flavouring?

g) What types of dhal, greens and vegetables are taken?

h) How much seasoning is generally used in food preparation?

i) Is there any food which the patient cannot, or will not, take?

2) Method of calculation

Based on the patient's food habits and the doctor's diet prescription the diet must be calculated as follows:

a) The minimum requirement of protein per day (i.e. 1g per kg body weight for an adult) should be met, unless the doctor orders any restriction.

b) Foods containing carbohydrate and fat must be added in the diet to make up the remainder of the requirement calories.

c) If an increased amount of any nutrient is required it should be administered through foods which the patient will not have difficulty in taking.

d) Check the diet qualitatively for mineral and vitamin content.

e) Adjust the special requirements accurately if necessary.

3) Methods of cooking

Ordinary methods of cooking may be used unless there is restriction of salt or fat or seasonings in the diet ordered. The quantity of fat or oil used needs to be reduced in diets of low Calorie value, and seasonings and spices must be reduced in bland diets, especially for gastric ulcer cases. Further preparation may be necessary after cooking, e.g., straining of vegetables where low residue diets have been ordered.

4) Education of the patient

It is often necessary for a patient to continue on the special diet after he is discharged from hospital, and he must therefore know details of his diet before he leaves. The reason for his special diet should be explained, clearly and simply, with stress on foods which must be increased or decreased. If any food is forbidden, the reason should be made quite clear. Alternative foods which may be allowed, to provide variety, should be given, and if possible the patient should be instructed regarding the length of time for which the special diet must be continued.

The quantities of food allowed should be weighed in hospital and shown to the patient in a common measure with which he is familiar so that he can estimate the right amount at home.

QUESTIONS FOR STUDY

1) Plan a full-liquid diet for one day which will contain 2,500 Calories. Provide normal protein, minerals and vitamins.
2) What changes might be necessary in a full diet for a patient as compared with your own diet?

CHAPTER 2

DIET THERAPY IN FEVERS

CHANGES IN METABOLISM IN FEVERS

Basal metabolic rate

For each degree Fahrenheit rise in temperature there is an increase of 6-7 percent in the Basal metabolic rate, so that the nutrition of a patient suffering from fever is very important if it is to meet these extra needs. If the fever is short and acute, the patient may soon recover his normal appetite, but if the fever is prolonged, it is essential that the diet given should be adequate to prevent wasting of the tissues.

Carbohydrate metabolism

Carbohydrate metabolism is always greatly influenced because it is the first substance used to provide the extra heat and energy required with the increased metabolic rate. If the food intake is greatly reduced the stores of glycogen in the liver will soon be used up.

Protein metabolism

Protein metabolism is usually greatly increased because of destruction of protein as a result of the infection. If an adequate amount of protein is not given, the body will use up the tissue proteins, and the patient will lose weight.

Fat metabolism

Fat metabolism in fevers does not differ very much from normal, except that if the total Calorie intake of the patient is inadequate, the body draws on the stores of fat. This may not be properly oxidized, and the patient will then develop ketosis. Adequate carbohydrate guards against this, and carbohydrate is therefore said to exert an anti-ketogenic action. If fever is accompanied by nausea and vomiting, it is advisable to cut down the fat content of the diet.

Water metabolism

Water metabolism may be upset in fever, but it is very important that adequate fluids should be given because water plays an important part in the regulation of body temperature.

Vitamin requirements

Vitamin requirements are also often altered during fever. Vitamin C requirement is always high, and the vitamin A intake may need to be increased because it is not well absorbed from the small intestine during fevers. If the diet is high in carbohydrate, as it should be and especially if the greater part of that carbohydrate comes from sugar and glucose, there is an increased demand for the B Complex vitamins. These vitamins may not be well absorbed if there is gastro-intestinal disturbance with the fever.

DIETARY CHANGES RELATED TO METABOLIC CHANGES

During fevers, the body is already in a toxic state; therefore anything which would cause further harm must be avoided. In short fevers plenty of fluids must be given to prevent dehydration. The patient should be spared all unnecessary exertion by being given foods, which are bland and easily digested, and the carbohydrate content must be kept high so that the patient does not use his body fat for energy.

In acute fevers, it is necessary to give small feeds at frequent intervals, because the digestion may be affected, and there will be loss of appetite and nausea. The patient's appetite will be some guide as to the amount of food which is to be given, but the maximum amount which can be tolerated should be given from the beginning. The following foods are usually allowed: milk, soup, eggs, cereals, fruit juices, glucose and honey, and boiled sweets if the patient desires. These foods should be given mainly as fluids with any flavouring which the patient likes e.g., tea, coffee, malted milks, meat or yeast extracts, other essences, to give variety and avoid monotony. Oil could be added to the gruel to increase Calories.

Typhoid fever

In the course of typhoid fever, the body temperature may be high for 21-28 days, although this time has now been considerably shortened by the use of modern drugs. This temperature rise results in an increase of metabolic rate of 20-40 percent.

Changes in metabolism

Carbohydrate metabolism is the same as in health. Fat metabolism does not differ greatly except that if the patient takes very little food, the body fat will be used to supply energy, and the body protein may also be used leading to loss of weight. There is also great destruction of protein due possibly to the toxic action of the infection. This destruction may be as much as three times the normal wear and tear of the tissues. The intestinal tract becomes highly inflamed and irritable.

Diet therapy

To compensate for the increase in metabolic rate, a high calorie diet should be given supplying 40-50 Calories per kg of body weight instead of the normal 35 Calories per kg of body weight for a sedentary man. The protein should be high, aiming at 100 gm per day. The most easily digested and efficiently used protein foods, milk and eggs, should be used liberally. The diet should be free from roughage because of the intestinal inflammation.

The very high calorie diet may not be tolerated well at first. Thus, it may be necessary to begin with 2,000 Calories and increased gradually to 3,000 Calories or more. A sample meal pattern for a High Protein, High Calories, Low Fibre semi-solid diet is given below.

HIGH PROTEIN, HIGH CALORIE, LOW-FIBRE DIET
(Protein-80 gm: Calories-2000)
TYPHOID DIET

6 A.M.	Milk
8 A.M	Sooji or strained porridge with milk and sugar
	soft cooked egg
	Coffee or tea with milk
	Fruit juice
Mid morning	Egg flip
Lunch	well cooked very soft rice or porridge
	Curd
	Ice-cream
3 P.M.	Milk with tea or coffee
	Plain biscuits or cake
5 P.M.	Strained fruit juice
Dinner	Cream soup
	Bread or toast with butter
	Soft cooked egg
	Custard
Late night	Milk with protein supplement

In the diet a minimum of the following may be used along with protein supplements:

Milk	1200ml
Eggs	4
Glucose	100g
Cereal	100g
Oranges	4

Milk may be given in any form palatable to the patient, flavoured with tea, coffee, malted milks, as curd or buttermilk, ice cream or custard. The eggs should be soft-cooked, or mixed with milk as egg flip. Cereal foods should be free from roughage, (sooji) and should be well cooked. Fruit juices should be strained. The total fluid should be 3,000 ml.

As the patient's tolerance for these foods increases the quantities should be gradually increased. Other bland low residue foods may be added as the patient's condition improves.

Pulmonary Tuberculosis

In tuberculosis the fever is more prolonged than in typhoid fever, but the metabolic rate is not so high. The patient may have a temperature of 99oF or 100oF for a year or more and unless the food intake is adequate, the patient will lose weight.

Changes in Metabolism

The metabolism of the various nutrients is generally normal, but the stimulating effect of metabolism of large quantities of protein (specific Dynamic Action of Protein) causes an increase in pulmonary ventilation, which is not always advisable.

Dietary Therapy

Adequate nutrition plays an important part, along with fresh air, rest, change of environment and various drugs, in the treatment of tuberculosis. One of the aims must be to prevent emaciation. In the past forced feeding was sometimes used to promote gain of weight. An improvement of the condition leads to gain of weight on an adequate diet.

The Principles of Diet Therapy for Tuberculosis Are.

1) It should be moderately high in protein to promote healing and high enough in calories to regain lost weight. The protein intake should average from 75 to 100g per day for adults and calorie intake 2500-3000 calories.

2) The diet should include all the foods rich in minerals and vitamins. Calcium is important for the calcification of the tuberculous nodes. Iron is necessary if there has been hemoptysis. The diet should be rich in ascorbic acid.

3) Fluids upto 3000 ml per day should be given unless the patient is oedamatous. Of the foods especially indicated in tuberculosis, milk is important because of its high content of excellent protein, calcium and vitamins. At least a litre of milk a day should be consumed in any form. Eggs, meat, fish, cheese and dhals should be consumed freely. Fruits and vegetables should be included because of their richness in vitamins and minerals. Fats and carbohydrates in abundance will help to meet the calorie needs. For vegetarian diets, the flesh foods must be omitted but the protein content can be maintained by adding more milk, curds, and skimmed milk powder.

Food should be bland, easily digested, varied and served attractively.

The foods given in the following table must be divided among the main meals of the day with in-between meal light feedings to get the full quantity of food for the day. It should be noted that cereal foods, wheat, rice, and bread, are small in amount in many Indian diets. However these cannot be increased because it would be at the expense of the foods needed to provide the protein content of the diet.

HIGH CALORIE, HIGH CARBOHYDRATE, HIGH PROTEIN DIET

Breakfast	Coffee with milk 200 ml Cereal-3 servings (e.g., 3 Iddlies) Egg-1 Plantain-1
10 A.M.	Juice of two fruits
Lunch	Cooked rice-2 cups Meat 50g-one serving Dhal 25g-one serving

	Vegetables-one serving Curds-200 ml Sambar or dhal curry
4 P.M.	Milk 200 ml with tea Snack-2 pieces Fruit-1
Dinner	Rice cooked 2 cups or rotis 4 Meat-50g (one serving) Dhal-25g (one serving) Curds-200 m Vegetable-1 serving Rasam
Late night	Milk 200 ml

Sugar, Oil and Butter could be taken as desired.

For the vegetarian diets the protein content can be maintained by adding more milk, curds and skimmed milk powder, and the fat content maintained by adding more butter and ghee.

QUESTONS FOR STUDY

1) Compare the average changes in basal metabolic rate in fever, with changes in typhoid and tuberculosis. What does this indicate about the diet for these conditions?
2) How many carbohydrate and proteins be increased in a bland liquid-soft diet without increasing the bulk?
3) Plan a day's diet for a typhoid patient providing 3,000 Calories a day and adequate fluids. Show the division into feedings.
4) Plan a day's diet for a tuberculosis patient providing 100gm of protein or more and 4,000 Calories. Show the division into feedings.

CHAPTER 3

DIET THERAPY IN RELATION TO CONDITION OF THE GASTRO-INTESTINAL TRACT

Conditions of the gastro-intestinal tract may be functional or organic, and may sometimes require surgery. A functional disease is one in which the activity or functioning of an organ may be disturbed and abnormal although there is no apparent injury to the organ itself. An organic disease is one in which there are changes or injury in the structure of the organ.

FUNCTIONAL DISORDERS

The functional disorders of the gastro-intestinal tract are:

1) Excessive or defective secretion and motility.

2) Vomiting.

3) Diarrhoea.

4) Flatulence.

5) Malabsorption.

Excessive or defective secretion and motility.

These conditions may be due to disturbed mental conditions or may be purely functional.

Excessive secretion of saliva and gastric juice is often associated with a motile stomach and small intestine, and a spastic colon, which leads to constipation.

Defective secretion and hypochlorhydria or decreased secretion of hypochloric acid, are often associated with a dilated stomach and small intestine and a dilated, lazy colon, which also leads to constipation.

In both conditions therefore, constipation is liable to occur, but the two types require different ways of dietary treatment.

In the treatment of excessive secretion and motility, it is better for the patient to eat food with a high fat content, to depress secretion, but to avoid much roughage so that there is not an excess of residue left in the colon for elimination. In avoiding roughage, most of which comes from fruits and vegetables; care must be taken to see that there is no deficiency of Vitamin C. It is advisable for the patient to drink plenty of fluids with meals, to dilute the gastric secretion.

For defective secretion and motility, food should be attractive, tasty, and finely chopped to stimulate secretion of the digestive juices. To promote digestion, it is better that food be taken rather dry, but that the patient should be encouraged to drink plenty of fluids between meals. A high roughage content may be taken to leave a larger quantity of residue in the colon, and thus stimulate peristalsis.

The fibre content of foods is as follows

Foods Having High Fibre Content.

1) All whole grain cereals, and their products like Ragi, Cholam, Cornflakes, Brown-bread, Wheat bran, puffed wheat, unpolished Rice etc.
2) All whole grains and legumes like Chole, Rajma, Dry-peas etc.
3) Edible skins and seeds of fresh fruits and vegetables.
4) Green leafy vegetables.
5) Raw vegetable salads.
6) Nuts and dried fruits.

Foods having a moderate fibre content.

1) Fruits with no skins and seeds.
2) Tender root and stem vegetables. Pureed vegetables.
3) Foods having little or no fibre.
4) Strained fruit juices and tomato juice.
5) White bread, toasted, or as rusk.

6) Rice, tapioca, arrowroot, cornflour, in small quantities.

7) Plain biscuits and plain cake.

8) Milk, eggs, cream, buttter.

9) Sugar, jaggery, honey, syrup, boiled sweets.

10) Tea, coffee, malted milks, yeast and meat extracts.

11) Mutton, fish (no bones), liver, chicken, brain.

High Fibre-Diet

Fibre is present in naturally occurring foods especially in fresh fruits, vegetables, and whole grain cereals. High fibre diets retard the absorption of cholesterol and so help to lower blood cholesterol levels, help to control diabetes more effectively and also prevent constipation by increasing bowel movements. Roughage (fibre) is also known to combat many typically modern western diseases such as diverticular disease, appendicitis, hiatus hernia, piles, bowel cancer and obesity.

Composition of High Fibre (residue) diets for adults (Calories 2400 Kcal protein 60-70 gm)

Food Stuffs	Gm/head/day Vegetarian	Non-Vegetarian
Whole cereals	350	350
Whole legumes	80	80
Dhal	50	50
Milk	600	400
Meat		40
Eggs		30
Green leafy vegetables	100	100
Other vegetables	200	200
Roots & Tubers	100	100
Oils and Fats	50	50
Sugar & Jaggery	50	50

Vomiting

Vomiting may be due to many causes and occurs in many conditions, e.g., irritation of the gastric mucous membrane by some toxin in food, chemical poison or drug administered as an emetic. It may also be due to ketosis, an abnormal production of acetone bodies during metabolism. Whatever the cause, the dietary treatment is the same. Since vomiting results in loss of fluid from the body, it is important that this should be restored.

Commence feeding by giving water or clear fluids with a little glucose or sugar, and then as tolerated, add other fluids and bland, soft solid preparations, pushing carbohydrate as sugar and well-cooked cereals and dry toast, but eliminating all fat from the diet.

Diarrhoea

Diarrhoea is really a symptom and may be either functional or organic in origin. It may occur as an acute, short attack or as a long continuous chronic condition but in any case it involves the loss of much fluid from the body. Any person especially a child with watery diarrhoea is in danger of dehydration and so he should be started with Rehydration drink or oral Rehydration solution as soon as possible.

Plenty of fluids must be given to prevent dehydration. Home available fluids (HAF) should be given like-*ganjee* water (Boiled Rice water) lassi, dhal soup, tender coconut water, lime juice etc. Mother's milk, and the special drink with ORS packet and soft foods must be given frequently throughout the day. Extra food after diarrhoea has been controlled should be given. Continue feeding during diarrhoea soft foods like kichri, mashed bananas, idlis and dahi. Feed the child as frequently as possible, several times a day for atleast a week. This will help the child to make up all the meals missed.

Long continuous diarrrhoea may be due to ulcerative colitis or to infection such as dysenteries or typhoid fever which are really organic conditions. Dietary treatment should be as for a short attack, but without the initial 24 hours on fluids only, if the patient is able to tolerate solid food. The patient must have a highly protective diet, fully balanced and of high Calorie value, but nonresidual. Specific

quantities for use in typhoid fever are given on page 219 and the residue content of foods is given on page 225. If the stools passed are acid, the carbohydrate, particularly sugars, should be cut down; if the stools are very offensive in smell, flesh foods should not be given, but adequate protein must be given as milk, if the stools are fatty, the fat content of the diet must be cut down, and milk prepared from skimmed milk powder given instead of whole milk.

Flatulence

Flatulence is usually caused by the swallowing of air, resulting in nausea and epigastric pain. It may also be due to carbohydrate fermentation in which case the carbohydrate content of the diet should be decreased, but this is usually not necessary unless an unusual organism is found in the stools. Some people suffer from flatulence after taking one or more specific foods, but there are great individual variations. Foods most likely to cause trouble are onions, garlic, cabbage, cauliflower, and preparations of dried peas and beans. Patients may therefore be advised to note the effect of eating these foods and directed to avoid them if found to cause trouble.

Malabsorption

Various conditions, not yet fully understood may result in malabsorption. This may be due to improper absorption of nutrients, particularly fat, from the intestine.

Coeliac disease is a condition found in children in which fat is not properly absorbed. Fat digestion is usually complete but the stools contain a high proportion of fatty acids and calcium soaps. The earlier treatment was to cut down the fat content of the diet, but it has now been found that the substance which prevents the absorption of the fat is gluten, one of the proteins present in wheat, rye and ragi. If these foods and all preparations made from them are excluded from the diet other foods may be given as required and absorption of fat is normal.

ORGANIC DISORDERS

Organic disorders of the gastrointestinal tract include:

1) Gastric and duodenal ulcers.

2) Pyloric stenosis.

3) Carcinoma and other conditions which cause obstruction in the oesophagus or stomach.

Gastric and duodenal ulcers.

An ulcer is formed in the stomach or duodenum usually as a result of the secretion of excess hydrochloric acid on the mucous membrane. Other causes which may contribute to the development of an ulcer are infrequent meals, inadequate chewing of food, excessive alcohol or smoking on an empty stomach, fear and other emotional disturbances which may cause hypersecretion and hypermotility of the stomach and at the same time a reduction of the blood supply to the stomach.

Symptoms.

The commonest symptom of an ulcer is pain after food, about ½ hour after food if the ulcer is in the duodenum. Usually the pain is relieved by taking more food. Vomiting is frequent and the vomitus and stools may contain blood. A chronic, bleeding ulcer, in time, leads to anaemia.

Modification of the diet.

Treatment of various kinds has been recommended. Originally, patients with bleeding ulcers were given only ice to suck. Modern dietary treatment is based on the principles laid down by *Lenhartz* (1996), *Sippy* (1915), and *Meulengracht* (1935).

The diet recommended by *Lenhartz* began by feeding patients by mouth with very small amounts of milk, or milk and egg mixture gradually increasing the daily amounts.

The diet recommended by *Sippy* was very similar to the above, but more cream was used. One hundred ml of milk and cream were given

on an hourly basis. Antacids were given between each feeding. Only milk was used for two days in Sippy's original diet. Soft-cooked eggs with toast and cereal were then added during the first week. Quantities were increased and more foods added during the second week; a normal pattern was established during the third week with three small meals and feedings at intervals between meals. Numerous modifications of Sippy's diet have been used.

The diet recommended by *Meulengracht* was based on the belief that patients with haemorrhage had a much lower mortality rate if they were given a fully adequate diet. Thus these patients were given a full pureed diet from the beginning. This means that all foods, including meats and vegetables, were given in a pureed or finely minced form. This provided adequate nourishment for the patient.

At present the generally accepted aims in the dietary management of the patient with gastric or duodenal ulcers are:

1) To provide adequate nutrition.

2) To give rest.

3) To continuously neutralize the gastric acid.

4) To inhibit the production of gastric acid.

5) To reduce mechanical, chemical, and thermal irritants.

In an effort to give adequate nutrition it must be remembered that the basic calorie, protein, mineral and vitamin requirement of the patient with a peptic ulcer are similar to those of a normal healthy person. Iron, ascorbic acid and essential amino acids should be given in liberal amounts. Therefore, a selection of food which is only slightly limited is recommended.

Only a small amount of food should be taken at each feeding. This is done in order to provide adequate rest.

A constant dilution and neutralization of the gastric acid is necessary. In order to accomplish this, 1 ½ to 2 hourly intervals between feedings are recommended. Protein foods such as milk, eggs and meat have a high acid-buffering capacity and are used for this purpose.

The production of gastric acid can also be inhibited by the use of specific foods. Cream, butter and egg yolk, all easily digested fats, inhibit the secretion of gastric juice and acid.

Mechanical irritants are composed of cellulose and are the edible skins, seeds and fibres found in fruits and vegetables. Foods that have a high content of cellulose should be either omitted from the diet or put through a sieve to make a puree. Chemical irritants are mainly the condiments and spices used in cooking such as chillies, pepper, ginger and mustard. Thermal irritants are very hot or very cold foods. These can be either omitted from the diet or taken by eating very slowly.

On the basis of the principles mentioned above, a bland diet in four stages forms the basis of present day treatment of the patient with peptic ulcer. The first three stages are usually used when the patient is in bed. The last stage is adaptable to a normal pattern of life and can be followed even after discharge. There are gradual increases in the kind and amount of food given. This allows the patient to begin at the most appropriate stage according to his condition. The particular stage at which the patient's diet may begin is decided by the doctor. Progress depends on the toleration of the patient.

STAGE. I

Meal plan: Milk and sugar, in quantities as ordered by the doctor, to be taken at specified intervals. For example, 180 ml of milk may be given every two hours. Milk with cream may be given if it is available. Minerals and vitamins must be given as supplements.

STAGE. II

Meal plan: Milk and sugar, in quantities as ordered by the doctor, may be given every four hours. In addition to this, small quantities of food chosen from the list below may be given. These may be given in any combination between the milk feedings. Minerals and vitamins must be supplemented.

Strained cereal congee (gruel), Soft cooked egg,
Custard (soft), White bread (toast preferred), Jelly,

Egg flip (egg-nog),	White potato (without skin),		Butter,
Well-cooked rice,	Sugar,	Milk,	Toast,
Salt,	Sweet curds,	Vanilla ice-cream	
Biscuits,			

Sample menu

6 a.m.	Milk 150 ml
8 a.m.	Strained wheat flour porridge with milk and sugar
10 a.m.	Milk-150 ml
Noon	Twice boiled rice, sweet curds
2 p.m.	Milk-150 ml
4 p.m.	Custard
6 p.m.	Milk-150 ml
8 p.m.	Toast-1 slice with butter; egg-1 soft cooked
10 p.m.	Milk-200 ml

STAGE III

Meal plan: Continue with milk five times per day as ordered by the doctor. In addition to this, give small servings of the following foods at regular meal times.

Iddly, iddiappam, puttu,	Plain biscuits
Uppamav (withoutmustard or Chilly)	Strained fruit juice
Well-cooked rice	Ripe plantain
Sago	Pureed vegetables
Arrowroot	Pureed fruits
Puffed rice	Mashed dhal
Soft minced fish, mutton, chicken	
Or liver	
Plain cake	

Sample menu

6 a.m.	Milk-150 ml
8 a.m.	Iddly-1 egg-1 (1/2 boiled or poached) Milk-150 ml
10 a.m.	Milk-200 ml
Noon	Twice boiled rice ½ cup Minced meat Soft pureed carrot or beetroot Curds-1/2 cup
3 p.m.	Milk-150 ml and plain biscuits
5 p.m.	Strained fruit juices
8 p.m.	Twice boiled rice ½ cup Pureed vegetable Curds 1 cup Milk, custard
Late Night	Milk 200 ml

Meal plan: During this stage the patient is given a fairly normal diet, bland in nature and consisting of three main meals (reduced quantity) with in-between snacks.

Foods allowed

Milk at least 2 cups daily:	milk beverage, butter milk, malted milks.
Eggs...	prepared in any way except frying.
Meat, fish, poultry... fish meal...	tender mutton, chicken, beef, liver, fish if tough, these may be minced or baked.
Cereals well cooked...	rice, oatmeal, sooji, iddly, samia, iddiappam,puttu, uppuma, sago,

	arrowroot,puffed rice, malted ragi, macaroni, noodles, spaghetti.
Vegetables soft...	potato, carrot, beetroot, tapioca, pumpkin, gourds,chow-chow, cauliflower, raw plantain, brinjal, tomato, green peas, greens without skins and seeds in pureed form.
Fruit...free of skin, seeds and fibre;	ripe banana, plantain,mango pulp, papaya, melon, apple stewed fruits.
Soups...	creamed and made with vegetable purees.
Dhals...	well-cooked and mashed.
Desserts...	corn starch puddings, milk and egg desserts, cake, gelatine desserts, ice-cream, plain payasam, plain biscuits.
Fats...	Cream, butter, margarine, ghee, cooking oil, vanaspathy.
Sugars...	sugar, clear fruit jam (or jelly), honey, jaggery.
Beverage...	weak tea or coffee, cocoa.
Condiments...	salt, turmeric, onion, coconut, ground coriander.

Foods to be avoided

1) All fried foods, pastries and nuts.
2) Skin and seeds of all vegetables and fruits.
3) Preparations made out of whole grain cereals like brown bread.
4) Whole pulses.
5) Concentrated sweets and syrup.

6) Spices such as chilies, pepper, ginger, garlic, mustards cloves, and pickles.

7) Strong tea and coffee.

8) Avoid alcohol.

Sample meal plan

Breakfast	Idli-2 with bland curry or bread with butter Egg-1 poached Plantain Milk-200 ml
Mid-morning	Fruit juice strained
Lunch	Well-cooked rice-1 cup Meat or fish Soft carrot Curds
3 p.m.	Milk-200 ml Biscuits-2 as sandwich Fruits
5 p.m.	Milk-1/2 cup, if necessary
7 p.m.	Well-cooked rice 1 cup Fish or meat Soft vegetable Curds
9 p.m.	Milk 200 ml.

(Milk may be taken as necessary between meals. Mutton and fish may be taken for lunch and dinner if it is within the means of the patient.)

Post-operative diet

Diets following surgery for peptic ulcer are very similar to diets for treatment of ulcers. The purpose of such a diet is to avoid distention of the stomach and to continue the control of acidity and irritation as before.

In the immediate post-operative period the patient may be fed only intravenously until normal intestinal function is restored. Thereafter feedings should be small, bland, easily digested and given at frequent intervals.

Conditions which cause obstruction in oesophagus or stomach

Various conditions of the oesophagus and stomach, including carcinoma, may require surgery, and this sometimes necessitates the introduction of a gastrostomy tube for feeding. If the gastric secretion and digestion are normal, there is no need for special modification of the diet, provided that all foods are in liquid form, and can pass through the tube. The patient's diet in such a case must be adequate for his needs and fully balanced. Extra protein may be needed if further extensive surgery is planned.

Liquid diets-Tube feeding

Breakfast

Milk	400 ml (200+200)
Rice flour conjee	25 gm
Orange	1
Sugar	100 gms for the day
Raw egg	1

Lunch

Rice	25 gms
Oil	2 tsp

Orange	1
Milk	200 ml

Tea

Milk	200 ml
Raw egg	1

Dinner

Thin Wheat conjee	25 gm
Oil	2 tsp
Orange	1
Milk	400 ml
Approximate calories	1900 without blend
Protein	55 gm

Jejunostomy Feeding

Feeding directly into the jejunum is sometimes temporily necessary when further surgery is planned, or indefinitely, if the normal route for food is blocked as a result of surgery or cancer. This is however, more difficult than feeding by gastrostomy tube. The stomach normally receives food for digestion, but this is already partly digested by the time it is passed on to the duodenum and jejunum, and it is allowed to pass through the plyloric phincter only in small quantities at very frequent intervals. Any substance, either undigested food or medicine which is introduced directly in the jejunum is liable to cause excessive peristalisis, giving colic, flatulence and diarrhoea. Thus the aim in jejunostomy feeding is to imitate the natural process. For this four conditions have been found to be important.

(a) Protein should be partly digested (peptonised)

(b) Sugar concentration should not exceed 10 percent.

(c) Fat content should be low.

(d) Food should be administered by drip method, and at body

temperature.

For the first two days, dilute skimmed milk and diluted orange juice, 120-150 ml may be given alternately every 1 or 2 hours either by continuous drip, or by drip for 40 minutes and rest for 20 minutes every hour. Sugar may be added to give not more than 10 percent concentration, i.e., not more than one level teaspoon sugar to 25 ml fluid.

The concentration of milk feeds may then be increased day by day till a tubefeeding formula giving adequate nutrients is introduced.

Sample formula

Special Blend

Milk...	600 ml
Egg	1
Sugar	50 gms
Casilan	50 gms
Rice flour porridge (to be made into conjee)	50 gms

Meal plan

Breakfast

Milk	300 ml
Oranges	2

Lunch

Special Blend

Tea

Oranges	2
Milk	300 ml

Dinner

Special Blend.

To start with 1000 calories and increase to 3000 calories as required by adjusting the amount of blend.

If medicines are to be given by jejunostomy, they should be mixed with 100-120 ml of a milk feed and given at the same rate as a milk feed.

QUESTIONS FOR STUDY

1) What two different conditions may cause constipation? Explain how this happens. What kind of foods should be given in each case, and which ones avoided? Explain why?
2) List some foods to avoid when a patient has diarrhoea. Has frequent flatulence. Has coeliac disease.
3) Plan two high protein feedings which could be passed through a tube. How much protein is there in 100 ml of these feedings? Plan one of these without the use of milk.
4) What type of ulcer diet is common in your hospital? How are the principles of diet for ulcer patients carried out in this diet?
5) Name some foods which stimulate gastric secretion. Which foods help most for neutralizing acid?
6) Plan three between-meal feedings for an ulcer patient who must carry his food to work?

CHAPTER 4

DIET THERAPHY IN DISEASES OF THE LIVER AND GALLBLADDER

THE FUNCTIONS OF THE LIVER

The liver has so many functions that if it is diseased the body may be very greatly affected. The functions of the liver may be classified under three main headings:

1) Metabolic functions.

2) Production and storage.

3) Protective functions.

1) Metabolic functions

In carbohydrate metabolism, the liver functions as the chief place of storage of glucose as glycogen.

In protein metabolism, amino acids which are not required for building up body protein, or for manufacture of hormones and other secretions are broken down in the liver. The amino group is split off (deamination) forming ammonia and a keto acid and can be used for energy. The ammonia is a converted into urea to be removed by the kidneys, and be used for energy. The liver also builds up proteins for special uses from the animo acids available.

In fat metabolism, the liver is the chief site of the constant changes in the nature and commposition of fatty acids, and the production of ketone bodies in the early stages of oxidation of fatty acid.

2) Production and storage

In the liver, bile, fibrinogen, prothrombin and heparin are produced. The liver stores the anti-anaemic factor (vitamin B12), Vitamin A, iron and copper. It also helps in regulating the volume of circulating blood.

3) Productive functions

The liver helps to free the body from toxic substances by its protective function of detoxication, and by the phagocytic action of the Kupffer cells of the reticulo-endothelial system.

CHANGES IN METABOLISM IN LIVER DISEASES

Any of the above functions may be affected if the liver is diseased. Carbohydrate is usually well metabolised and the liver functions better with good stores of glycogen than without.

The formation of urea from amino acids is probably the last of the liver functions to be affected. Protein is required for repair of the tissues including liver cells, and if the protein content of the diet is reduced, protein from other tissues may be metabolised. The liver also plays an important part in the manufacture of plasma protein, especially ablumin.

Fat metabolism may be considerably affected, especially if the bile is unable to get through to the intestine and fat cannot be adequately digested and absorbed. Disease of the liver may also lead to accumulation of fat in the liver tissue (fatty infiltration).

DIET THERAPY IN RELATION TO METABOLIC CHANGES

Patients with liver disease often suffer from nausea and vomiting which may result in loss of salt and fluid, so that these two items may have to be considered first.

Carbohydrates in the diet should be high to supply the liver with glycogen, and to prevent the tendency to ketosis. If adequate glucose and fluid cannot be tolerated by mouth because of vomiting, it must be given by intravenous infusion.

The protein content of the diet should be high in order to maintain the body and help in the rebuilding of the damaged tissue. If, however, the damage to the liver is severe, the liver may not be able to deal adequately with the metabolism of a large quantity of protein, and a reduction may be necessary. Whatever the protein content of the diet, a considerable part of it should come from skimmed milk, because

it contains the amino acid methionine. If the body has methionine, it can synthesise choline, a substance important in preventing the accumulation of fat in the liver.

A low fat diet was once prescribed routlinely for the patient with liver disease. This is no longer considered necessary, unless the patient must be taken. A moderate intake of fat, making the food more palatable and easier to prepare is recommended. The intake of fat also increases calories without adding too much bulk and supplies essential unsaturated fatty acids and far-soluble vitamins. Fats in whole milk, egg, butter and cream are easily digested and should be included in the diet. However, excessive amounts of fat in the diet should be avoided.

It is important that the patient should have adequate B Complex vitamins to help in the metabolism of the high carbohydrate diet. Adequate fat-soluble vitamins may be given as concentrates if the fat intake must be restricted.

Dietary treatment plays an important part in the two principal diseases of the liver; infectious hepatitis and cirrhosis of the liver.

INFECTIOUS HEPATITIS

Hepatitis is an inflammation of the liver as a result of either bacterial and viral infections or the presence of toxins and drugs. During the acute stage, this condition is usually characterized by anorexia, fever, headache, nausea and vomiting. The two essentials for treatment are rest and a High Carbohydrate, High Protein, Moderate Fat diet.

Diet therapy

In the acute stage the patient may not be able to tolerate even clear fluids by mouth due to severe anorexia and nausea. Intravenous food and fluids will have to be substituted during this time. However, liquids and solid foods should be given by mouth as soon as tolerated. The patient should then be given a High Carbohydrate, High Protein, and Moderate Fat diet until the laboratory tests indicate that the liver is functioning normally. The first list of foods below gives the amounts of specific foods, which should be included in the daily diet. Following

this is a list of foods, which may be allowed on this diet, and a list of foods, which should be avoided. This diet will give approximately 300 gm of carbohydrate, 85 gm of protein, 50 gm of fat and 2,000 Calories. Sugar, protein and fruits may be increased as supplements to increase the protein and carbohydrate content as the patient is able to tolerate them.

HIGH CARBOHYDRATE, HIGH PROTEIN, MODERATE FAT DIET

Milk	...	cow's 1,000 ml
Egg	...	1
Meat	...	lean meat, fish or chicken: 200 gm
Vegetables	...	at least one citrus fruit: 3
Fruits	...	at least one citrus fruit: 3
Cereal	...	240 gm minimum
Butter, or oil	...	1 tablespoon
Sugar	...	5 tablespoons.

	Foods Allowed	*Foods to Avoid*
Beverages	Milk, milk drinks, coffee, tea, cocoa, fruit juice, carbonated drinks .	Alcohol
Eggs	Soft cooked, may be used in deserts	Fried
Meat	Lean mutton, beef, fish, chicken	Fatty meat or fish, bacon, pork, goose, duck.
Dhals	Well cooked and mashed	Avoid if distension
Cereals	Rice, wheat, iddlies, ragi, ...	

Desserts	Ice-cream, custard, jellies, bread and cornflour puddings	Pastries, pies
Vegetables	Raw, cooked	Gas-forming such as cabbage, turnips, onions
Fruits	Fresh, canned, dried	....
Soup	Clear soups and broths	Those with fat
Condiments	In moderation	Excessive pepper and chillies
Sweets	Sugar, honey, jam, jaggery, syrup	Chocolates, sweets with nuts
Fats	Butter, ghee and vanaspathy in moderation	Fried foods

CIRRHOSIS OF THE LIVER

In cirrhosis of the liver there is general necrosis of the liver cells producing an overgrowth of connective tissue. There may be accumulation of fat in the liver tissue and considerable loss of liver function. Cirrhosis is very common in tropical countries and is associated with one or more of the following dietary defects:

1) Deficiency of protein, especially protein of high biological value.

2) Excess of carbohydrate, especially in rice diets.

3) Deficiency of vitamins.

4) Excess of irritating condiments, especially if associated with chronic alcoholism.

A patient with cirrhosis of the liver may suffer from ascites and accompanying abdominal discomfort, jaundice, loss of appetite, nausea and vomiting, thirst, weakness and mental dullness. There may also be hypoproteinaemia, fatty infiltration of the liver and esophageal varices.

Diet therapy

If the diet therapy is begun very early in the disease, there may be considerable improvement in the condition of the patient. The diet planned for the patient with infectious hepatitis is found satisfactory. A moderate to high protein, high carbohydrate diet can be used depending on the condition of the patient. If cirrhosis is more advanced, the following factors must be considered in planning the diet.

A moderate to high protein content is of advantage to most patients. However, great care should be used an it is possible for hepatic coma to set in. protein is given in amounts of 1-1 ½ gms/kg. body weight as per day, but this must be given according to the toleration of the patient. Liberal use of milk and commercial high protein food mixed with fresh milk is recommended. Skimmed milk is especially important because of its methionine content.

A moderate intake of fat is advised rather than complete restriction.

When cirrhosis is accompanied by ascites and peripheral edema, it is necessary to restrict the sodium content of the diet. Food lacking in salt is not palatable to most patients. Therefore, care must be taken in the preparation by using substitutes such as limejuice, tamarind and buttermilk. These provide sourness and make the food more acceptable. (Refer to Diet Therapy, Chapter 6, for further information regarding the Low Sodium diet).

If esophageal varices are present, a soft solid or liquid diet will be necessary. Vitamins must be supplemented.

HEPATIC PRECOMA AND COMA

Hepatic precoma and coma may occur in the following liver disorders.

(a) Viral hepatitis

(b) Cirrhosis of the liver

(c) Surgery of the liver for various disorders.

The condition is characterised by disordered consciousness confusion

and tremor of the outstretched hands. The possible causes are toxic effects of metabolic products of protein metabolism such as ammonia, indole skatole, phenols which are not detoxified by the damaged liver.

Prompt treatment is essential. The primary object in dietary management is to keep the protein metabolism to a minimum. This is done to reduce the amount of ammonia produced while at the same time by preventing catabolism of muscle protein. Enough calories are provided mainly from carbohydrates to keep the body tissue break down at a minimum.

Diet

Calories: the minimum calorie intake should be about 1000 Kcal and this should be in the form of glucose, sucrose and fruit juices.

Proteins: since nitrogenous products of protein metabolism appear to cause coma, no protein should be given. The endogenous breakdown of proteins is kept at a minimum by high carbohydrate diet, which spares proteins. The bacterial breakdown of proteins in the large intestines is inhabited by giving antibiotics. When the patient recovers from coma, protein can be given at low lovels (30 to 40 gms/day).

Carbohydrates: since glucose is utilised by the tissues even when the liver is damaged major portion of the carbohydrate should be in the form of glucose.

Fats: since fats are first metabolised in the liver, fat should not be given in this condition.

Vitamins and minerals: the daily requirements of vitamin should be added to the feed. Minerals should be given after estimating the sodium and pottassium levels.

The feeding is given as parenteral feeding or Nasogastric feeding 2000-2500 ml of 10% glucose is given intraveneously in 24 hours with the vitamins and minerals added in it. The nasogastric tube feeding can be prepared as follows:

Fruit juice with sugar, honey or glucose.

Arrowroot with sugar.

Sago porridge with sugar.

Vegetable broth-total amount: 2000 ml.

The daily requirements of vitamins can be dissolved in the above fluid. The feed should be given in 10 doses of 200 ml each at intervals of 2 hours starting from 6 A.M. to 12 midnight.

DISEASES OF THE GALLBLADDER

Diseases of the gallbladder for which changes in diet may help are:

Chronic cholecystitis.

Stones

Normally the gallbladder is emptied after each meal. If the bile duct is obstructed for any reason, as by infection, inflammation, stones or carcinoma, the bile does not get through to the intestine and fat may not be properly digested or absorbed. In such cases it is usually to restrict the fact content of the diet, through this is not essential, according to some physicians.

Stones are usually associated with chronic inflammation and if they are small, they may completely, block the duct. For these, surgical treatment is best, but the fact content of the diet is usually restricted until surgery is possible.

If fat is cut out of the diet completely, there is a tendency for the bile stored in the gallbladder to stagnate, on the other hand, too much fat leads to indigestion and pain when the gallbladder tries to contract.

The main constituent of gall stones is cholesterol, and a restriction of the cholesterol-containing foods has sometimes been recommended. Such foods are egg yolk, liver, kidney, brain, sweetbreads (pancreas), goose and duck.

The value of giving a cholesterol-free diet is doubtful since cholesterol is produced in the body during fat metabolism much more easily than it is absorbed from the intestine.

QUESTIONS FOR STUDY.

1) What are the reasons for giving a high protein, high carbohydrate and moderate fat diet in disturbances of metabolism caused by the liver disease?

2) Why is it necessary to give fat soluble vitamins medicinally to patients with liver disease?

3) Plan a day's diet for a patient with cirrhosis of the liver using the diet list suggested on page 242 dividing these into the meals of the day.

4) What is the reason for using a low-fat diet in gallbladder disease?

CHAPTER 5

DIET THERAPY IN CONDITIONS OF THE ENDOCRINE GLANDS AND METABOLISM

The endocrine glands are organs of internal secretion whose active secretions, the hormones, are passed directly into the blood stream and affect the body in various ways. The function of some of the endocrine glands is closely connected with metabolism, and a change in the gland may produce a marked change in metabolism, and a change in the gland may produce a marked change in metabolism. This in turn requires a change in the diet to meet the different state of the body and bring it into a new balance.

Conditions caused by changes in the endocrine glands which can be helped considerably by changes in diet are:

1) Diabetes mellitus.
2) Hyperinsulinism.
3) Hyperthyroidism and excessive leanness.
4) Obesity.

DIABETES MELLITUS

Diabetes mellitus is a condition in which the secretion of insulin by the Islets of Langerhans in the pancreas is deficient or absent. It is characterised by hyperglycaemia and glycosuria accompanied by polyuria, polydipsia, polyphagia, an if untreated for a long time, by loss of weight. There may be many other complications which develop as a result of the disease, e.g., reduced resistance to infection, tuberculosis, neuritis and pruritis, gangrene, and changes in the eyes and kidneys.

Changes in metabolism in diabetes mellitus

In diabetes mellitus, the metabolism of carbohydrate, fat and protein are affected.

Carbohydrate is not stored in the liver and muscles as glycogen, nor can it be adequately utilised in the body because of the lack of insulin. Glucose therefore accumulates in the blood until it reaches a level higher than that at which the kidneys can prevent its excretion. The glucose then passes into the urine and plycosuria results. The inability to use carbohydrate and its loss in the urine, means that the body loses its main source of energy. The metabolism of fat and protein is therefore increased to try to provide the body with adequate energy.

Fat is also not properly metabolised in deabetes mellitus. The availability of carbohydrate determines how much fat is broken down. Fatty acids are converted to ketone bodies in the liver, but the oxidation of ketone bodies is completed in other tissues of the body. When carbohydrate is not available, ketone bodies are produced in the liver much more quickly than they can be oxidised in the other tisses and therefore they accumulate in the blood, causing ketoacidosis, this may lead to dehydration and coma.

Protein metabolism is also increased to try to make up for the loss of carbohydrate, but during metabolsim, about 58 percent of the protein are converted to carbohydrate, which cannot be adequately used. When tissue protein is used in this way for a long time, the body wastes, and weight is lost.

DIETARY CHANGES RELATED TO METABOLOIC CHANGES

The treatment of diabetes depends upon the severity of the condition.

Mild diabetes commonly occurs in the middle-aged or elderly obese persons, with only a slight deficiency of insulin, and can often be controlled by restriction of the diet alone. In such cases, if the intake of food is reduced, the available insulin may be efficient to control the metabolism.

Serve diabetes occurs when there is very little insulin secreted in the body. This is found most commonly among young people. It is impossible to treat severe diabetes by diet alone; insulin given by injection or the use of oral hypoglycaemic agents will be required.

Diabetes is a life long disease, which can be treated, but not cured. The aim of treatment is to keep the patient in good health. The diet, therefore, must meet his nutritional needs. Each individual patient must have a diet planned specifically for him.

Many different schemes have been made for the dietary treatment of diabetes mellitus. Modifications of the normal diet are made on the following general principles.

1) The calorie intake should be adjusted to allow the patient to gain or lose weight as necessary until the desirable weight (or slightly below this level) has been reached.

2) The desired weight should then be kept constant.

3) The blood sugar should be maintained at a normal level by the use of insulin or oral medicines. Hypoglycaemia. Must be avoided.

4) The food that is given should satisfy the appetite.

5) The diet should be adjusted according to the economic means of the patient and his normal food habits.

Calories-The total intake of calories is important for a diabetic. It is best to keep a diabetic on a well balanced diet providing the lowest number of calories, which will maintain his body weight at 5% below his ideal body weight. The ideal body weight depends upon age, sex, height and body frame. Of the total calories required 20 to 25 percent should be from proteins, 40 percent from carbohydrates and 40 percent from fat.

Carbohydrates

There is disturbance of carbohydrate metabolism is diabetes as manifested by hyperglycemia and glycosuria. In a diabetic, drastic restriction of carbohydrate should not be advised as this further lowers the sugar tolerance. If adequate carbohydrates are given there is a reduction in fat metabolism and consequently less ketone body is formed. About 175g-250g of carbohydrate should be given to a diabetic of normal weight. This amount is decreased in an obese and increased in a thin diabetic.

Protein- A deit high in protein is good because it supplies the essential amino acids needed for tissue repair, does not raise the blood sugar during absorption as do carbohydrates, and does not supply as many calories as fats. One gram of protein per Kg. of body weight is adequate but more may be given and the amount of fats and carbohydrate proportionately reduced.

Fats are used to make up the balance of the total calories required. Fat never must be in sufficient quantities to produce ketosis. The type and level of the fat may have to be specified if artherosclerosis is also present. The normal intake of fats is usually used, but the poly-unsaturated fatty acid content may be adjusted so that 2/3 of the total fat could be from the vegetable oils and 1/3 from animal fat.

The diet should be adequate in terms of minerals and vitamins with special importance for vitamin B1 and Vitamin K.

Distribution of the diet

The amounts of food and the time at which they are given are very important. This is modified according to the need of the individual patient.

For patients controlled by diet alone the total calories are divided equally into three or four meals. In many patients the blood sugar is at a higher level in the morning. Therefore, a smaller breakfast may have to be given. The spacing of the meals will also depend on the type of insulin being used by the patient.

Soluble (regular) insulin is largely limited to use during surgery or for patients who have infection or diabetic coma. Food should be given within half an hour after the does of insulin has been given. Soluble insulin is quick acting, and the distribution of Calories depends on the pattern of injections, e.g. equal doses of soluble insulin given every 6 hours will require feedings containing equal amounts of Calories (carbohydrate, protein, and fat) every 6 hours.

The slow-acting insulin's and oral hypoglycemic tablets are used more commonly. In these cases, a late evening drink of milk essential in order to provide a slowly available form of carbohydrate. The calories are usually divided into 1/5, 2/5 and 2/5 for breakfast; lunch and

dinner after the Calories from the bedtime milk have been deducted from the total.

It is a well-established fact that diabetic patients who are regularly controlled by treatment with diet and medications have fewer complications than those who are not controlled in this way.

Food exchange lists

A moderately accurate method for prescribing the diet has been drawn up which reclassifies and standardizes the values of specific foods. This makes planning of the diet more simple for patients who are restricted to a low Calories intake.

There are eight food groups. The measurements are given in grams or millilitres, wherever possible, and in common household measures such as a cup of a size of fruit. As more of these common measures become popular and standard, these may be substituted effectively.

There are many exchangeable foods of about the same composition within each group. However, foods from one group cannot be exchanged for foods from another group. These exchange groups help the diabetic patient plan his diet so as to provide a variety within restrictions. Sample calculations for Low Calories diets are also given, listing the number of portions that can be used from each group for each meal.

FOOD EXCHANGES

Milk Exchange

Each milk exchange contains	*Prt. 3g, *CHO 4g, K. Cals. 65
Cow's milk	100 ml (½ cup)
Buffalo's milk	50 ml (½ cup)
Curds	100 ml (½ cup)
Skimmed milk	200 ml (1 cup)
Skimmed milk powder	18 g (5 tsp.)
Whole milk powder	13 g (3 tsp.)
Fat negligible	

Meat Exchange

Each meat exchange contains	*Prt. 7.5g, *CHO nil, Fat 6g, K.Cals. 85
Beef	75g
Chicken	75g
Liver	75g
Pork muscle	75g
Egg	1 (medium)
Mutton	50g
Fish	75-100g

Fish and liver contain small amounts of CHO. There is wide variation between items in this exchange.

*Prt. Protein

*CHO Carbohydrate

Fat Exchange

Each fat exchange contains	Fat 10g, K. Cals. 90, Prt, CHO nil.
Oil (any variety)	10g (3 pts.)
Ghee	10g (2 pts.)
Butter	12g (2 ½ pts.)
Vanaspathi	10g (2 pts.)
Margarine	10g

Cereal exchange

Each cereal exchange contains	Prt. 1-3 g. CHO 18-21g, Fat negligible, K. Cals. 85
Rice	25g (2 tbsp.)
Cooked rice	½ cup
Wheat ravai	25g (2 tbsp.)
Broken rice	25g (2 tbsp.)
Sooji	25g (2 tbsp.)

Oats	25g (3 ½ tbsp.)
Vermicelli	25g (2 ½ tbsp.)
Flakes	25g (5 tbsp.)
Wheat flour	25g (3 ½ tbsp.)
Ragi flour	25g (3 ½ tbsp.)
Rice flour	25g (2 tbsp.)
θ Arrowroot	25g (2 tbsp.)
θ Sago	25g (3 tbsp.)
Iddly	1 (medium size)
Dosai	1 (medium size)
Chappathi	1 (medium size)
Uppuma	½ cup
Noodles/Spaghetti	½ cup
Potato	100g
Yam	75 g
Colocasia	100g
Sweet potato	75g
Tapioca	50g
Bread	2 half inch slices

θ Protein negligible

Fruit Exchange

Each fruit exchange contains	CHO 10g K.Cals. 40 Prt. & Fat negligible.
Amla	4-5
Apple	1 (small)
Apricots	2 (fresh)
Banana	½ (small)
Custard apple	1 (small)
Dates	2
Grapes	20
Grapefruit	½ small
Guava	1 (medium size)

Jackfruit	3 pieces
Jamun	10 (small)
Mango	1 (small)
Melon	1 slice
Orange	1 (average)
Papaya	2″ x 3″ slice
Peach	1 (medium)
Pear	1 (small)
Pineapple	1 slice
Plums	2
Sapota (chikoo)	1 (small)
Strawberries	1 cup
Sweet lime	1 (medium size)
Watermelon	1 slice (200g)

Dhal Exchange

Each exchange contains	CHO 15g, Prt. 6g, K. Cals. 85, Fat negligible
Pulses	25g (½ cup, cooked)
Legumes	25g (½ cup, cooked)

Vegetable Exchange

Group A – Low calorie vegetables

Each exchange – ½ cup cooked vegetable.

CHO upto 6%	K. Cals. 30
Cabbage	Cauliflower
Celery	Chow chow
Lettuce	Cucumber
Mint	Drumstick
Spinach	Ladies fingers
Sirukeerai	French beans
White Radish	Capsicum

Paruppukeerai	Kovai
Amaranth	Knolkhol
Ash gourd	Green papaya
Bitter gourd	Plantain flower
Brinjal	Pumpkin
Tomatoes	Ridge gourd
	Snake gourd
	Fenugreek

Group B

Each exchange – ½ cup cooked vegetable

CHO 6-12%	Prt. 2-3 g.
K. Cals. 50-60	Drumstick leaves
Beetroot	Jackfruit
Carrot	Sword beans
Radish-Pink	
Turnip	Coriander leaves
Onion (big)	Onion (small)
Mango-ginger	Gogu
Broad beans	Double beans
Cluster beans	Turnip leaves

READY-RECKONER FOR FOOD SERVING

	Cooked Volume	Raw Wt. g.	CHO g.	Protein g.	Fat g.	K. Cals
Milk	½ cup	100 ml	4	3.2	4	65
Egg	1 med.	50 g	-	6.6	7	85
Meat	6-8 small pieces	45 g	-	8.3	6	85
Fish	1 slice	65 g		14.6	3	85
Chicken	1 slice	75 g	-	19.4	1	85
Pulses	½ cup	25 g	15	5.6	-	85
Rice	½ cup	25 g	20	1.6	-	85
Wheat	1 chappathi	25 g	18	3	-	85
Ragi	3 ½ tbsp.	25 g	18	1.8	1	85

Vegetable-list A	½ cup	100 g	6	1	-	30
Vegetable – list B	½ cup	100 g	10	2	-	50
Fruit	1	100 g	10	2	-	40
Plantain	1 med.	50 g	14	0.6	-	58
Groundnut	40-50, 1 ½ tbsp.	15 g	4	3.8	6	85
Sugar	2 tbsp.	10 g	10	-	-	40
Fat	2 tbsp.	10 g	-	-	10	90

LOW CALORIE DIETS IN EXCHANGES

	1000 Cal.		1500 Cal.		2000 Cal.	
	N.Veg.	Veg.	N.Veg.	Veg.	N.Veg.	Veg.
Breakfast:						
Coffee or Tea – Black	..	..	..	..	..	..
Milk (Exchanges)	1	1	1	2	2	2
Cereal (Exchanges)	1	1	2	2	3	3
Fruit (Exchanges)	..	..	..	..	1	1
Egg (Meat Exchanges)	..	..	1	..	1	..
Mid-morning:						
Butter milk or unsweetened lime juice	..	..	..	..	..	..
Noon:						
Cereal (Exchanges)	1	1	3	3	3	3
Meat (Exchanges)	1	..	1	..	1	..
Dhal (Exchanges)	..	1	..	1	..	1
Vegetables List A	1	1	1	1	1	1
List B	1	1	1	1	1	1
Curds (Milk Exchanges)	1	1	1	1	1	1
Sambar (Dhal exchanges)	..	..	1	2	1	1
Rasam	..	..	..	..	..	..

Evening:						
Coffee or Tea – Black	..	..	..	..	..	..
Milk (Exchanges)	1	1	1	1	1	2
Fruit (Exchanges)	1	1	1	1	1	2
Dinner:						
Cereal (Exchanges)	1	1	2	2	3	3
Dhal (Exchanges)	1	1	..	1	..	1
Meat (Exchanges)	..	..	1	..	1	..
Vegetables List A	1	1	1	1	1	1
List B	..	..	1	1	1	1
Curds (Milk Exchange)	1	1	1	1	1	1
Rasam	..	..	..	..	..	..
Late night:						
Milk (Exchanges)	1	1	2	2	3	3
Daily oil in cooking (Fat Exchanges)	1	1	1	1	1½	1½
Protein (gm)	38	35	59	52	75	67
Fat (gm)	36	30	48	38	55	51
Carbohydrate (gm)	126	141	206	236	275	308

1500 Calorie – liquid – diabetic diet

Breakfast:

Milk 400 ml	
Porridge	25 gm
Raw egg	1
Orange	1

Lunch:

Rice conjee	200 ml
Curds	200 ml

Orange	2

Tea:

Milk 200 ml	
Raw egg	1
Oranges	2

Dinner:

Porridge	200 ml
Buttermilk	400 ml
Orange	1
Calories	1470
Protein	54 gms
Proteinex	2 tsp/day

Diabetic children and pregnant women

Diabetic children need considerable supervision as the diabetic condition is usually severe, but they still need normal protein and Calories requirements for growth of the body, and for varying activity. Insulin requirements need frequent adjustments to keep pace with the changing dierary intake with growth and development and the varying energy output.

Pregnant women also need careful control; otherwise the large amounts of carbohydrate in the blood may cause the development of an abnormally large baby, making delivery difficult. It is however, essential to provide adequate food for the maintenance of the mother's body and for the development of the foetus.

Education of patients

Every diabetic person should know how to manage his diet, with exchange alternatives and variations to prevent monotony, and to unable him to lead as normal a life as possible. It will be necessary to weigh foods according to the doctor's orders and show the patient how to measure similar amounts with equipment which he has in his

Diets of different Calorie Value

	1200		1500		1800		2000		2500	
	Veg.	Non Veg.	Veg.	Non Veg.	Veg.	Non Veg.	Veg.	Non Veg.	Veg.	Non Veg.
Breakfast:										
Plain coffee/Tea Milk	50ml	50ml	100ml	100ml	200ml	200ml	250ml	250ml	300ml	300ml
Cereal	50gm	50gm	50gm	50gm	50gm	50gm	75gm	75gm	75ml	75ml
Fruit	1	1	..	..	..	..	..	..	..	..
Plantain	..	..	1	1	1	1	1	1	1	1
Egg	..	..	..	..	..	..	..	..	..	..
Mid-morning										
Dilute buttermilk	..	..	..	..	..	..	..	..	..	..
Fruit juice	..	..	..	1	1	1	1	1	1	2
Lunch:										
Cereal	50gm	50gm	75gm	75gm	75gm	75gm	75gm	75m	75gm	75gm
Dhal	25gm	..	25gm	..	25gm	..	25gm	..	25gm	..
Non-Vegetarian dish	..	50gm	..	50gm	..	50gm	..	50gm	..	100gm
Vegetable A	100gm	100gm	100gm	100gm	100gm	100gm	..	..	..	..
Curds	100ml	100ml	100ml	100ml	100ml	100ml	100ml	100ml	200ml	100ml
Sambar	100ml	100ml	100ml	100ml	100ml	100ml	100ml	100ml	100ml	100ml

Tea:										
Plain coffee/tea milk	50ml	50ml	100ml	100ml	200ml	200ml	200ml	200ml	300ml	250ml
Snack with 15 gm pulse	15gm	15gm	15gm	15gm	15gm	15gm	..	..	bread	1 slice
									Butter	5gm
Fruit	..	...	..	...	...	..	1	1	..	..
Dinner										
Cereal	50gm	50gm	50gm	50gm	75gm	75gm	75gm	75gm	75gm	75gm
Vegetable A	100gm	100gm	100gm	100gm	100gm	100gm	100gm	100gm	100gm	100gm
Vegetable B	100gm	100gm	100gm	100gm	100gm	100gm	100gm	100gm	100gm	100gm
Curds	100ml	100ml	100ml	100ml	100ml	100ml	100ml	100ml	200ml	100ml
Rasam	..	..	..	..	25gm	50gm	25gm	..	25gm	..
Dhal	..	..	..	..	..	..	..	50gm	..	50gm
Non-vegetarian dish	..	..	..	..	..	..	..	..	..	..
Bed time:										
Milk	100ml	100ml	200ml	200ml	200ml	200ml	200ml	250ml	300ml	200ml
Oil in cooking	15gm	15gm	1gm	15gm	15gm	15gm	15gm	15gm	25gm	20gm
Approximate percentage of nutrients in calories										
Carbohydrates	64	59.3	63	58.8	61.7	54.9	63.4	56	57.3	52.4
Protein	12.4	13.3	13.4	13.8	14.5	15.2	13.4	1.7	13	15
Fat	23.6	27.4	23	27.4	23.8	29.9	23.2	29.3	29.7	32.6

home. Patients will not realize the importance of amounts of foods as well as choice of foods unless the reason is carefully explained and emphasized. If he is able to give his own insulin injections, instructions regarding this and regarding the testing of urine will also have to be given. He should be familiar with the signs and symptoms of hypoglycaemic attacks so that he can avoid disability and know what to do if he feels such an attack coming on.

HYPERINSULINISM

In hyperinsulinism, the production of insulin in the Islet tissue exceeds normal, and causes the storage of glucose as glycogen at the expense of the blood sugar, which therefore tends to be low. It is of little value to give additional carbohydrate in the diet because it is quickly stored as glycogen and the patient becomes hypoglycaemic again. The retention of sugar in the body may also lead to obesity. The general plan of dietary treatment is as follows:

a) Restrict the total Calories to the individual's requirements, or a less if he is obese.

b) Restrict the total carbohydrate and fat within the limit of the total Calorie value.

c) Give a high protein diet, with protein food every two hours so that the protein is available throughout the day for slow conversion to carbohydrate for the maintenance of the normal blood sugar level.

e.g., Carbohydrate	150 gm.
Protein	130 gm.
Fat	42 gm.

HYPERTHYROIDISM AND EXCESSIVE LEANNESS

The two conditions may be due to very different causes, but the dietary treatment is the same, and therefore they may be considered together.

Hyperthyroidism is due to overactivity of the thyroid gland causing an increase of anything up to 100 percent in the Basal Metabolic Rate.

With this enormous increase in energy expenditure, the patient must call upon all the body resources, and may quickly use up the store of fat, and even the body protein, so that the body wastes. Such a condition is usually treated surgically, but before this is possible the patient must have complete rest and a high Calories diet to provide for the increase in metabolism and to help restore the wasted tissues.

Excessive leanness treatment is to give a fully balanced diet, with high protein, and extra Calories from carbohydrate and fat wherever possible. The protein should be easily digestible and therefore, fortified milk preparations (milk with added milk powder and sometimes egg) are especially useful. Glucose or lactose may be added to all possible foods and drinks, and used in preference to sugar because they are not too sweet. Butter, ghee or cream should also be added to foods wherever possible to increase the Calorie value.

Quantities of foods given for the high Calories diet for pulmonary tuberculosis on page **219** may also be given in cases of hyperthyroidism and excessive leanness.

OBESITY

Obesity is the condition of the body in which the weight is considerably greater than average for height and age. There is a tendency for everyone to put on weight as age advances, but as it is not advisable to put on weight after the age of 40 years, the average weight for height at that age should be taken as an approximate weight for the rest of life.

Causes of Obesity

There is only one way in which a person can put on weight, and that is by eating more than his body requires. Many factors may help to cause this, such as:

a) The need for some form of bodily satisfaction when there is emotional disturbance.

b) the excessive use of alcohol which adds Calories in liquid form in addition to a full diet.

c) Reduction in the body's requirements due to changes in

secretion of some of the endocrine glands, e.g., myxoedema in hypothyroidism, Frohlich's syndrome due to deficiency of pituitary secretion, Cushing's syndrome due to over-activity of the adrenal cortex.

Dangers of Obesity

Many pathological conditions are found to occur more frequently in those who are obese than in those of normal weight, e.g., coronary disease, arteriosclerosis and hypertension, diabetes, gallstones, and hernia. In addition, the risks involved in surgery are much greater and any diseased condition involving the legs may take much longer to heal because of the excessive weight which has to be carried.

Slimming or reducing weight should not be undertaken except under medical supervision, and doctors do not consider that it is necessary to slim unless the weight is more than 10 percent above normal. There are certain advantages, however: it improves the appearance; it reduces the work for the heart which is especially important after 45 years of age; there is less incidence of disease; and in arthritis conditions there is less pressure on the joints.

Changes in metabolism in obesity

Unless there is some underlying cause as in deficiency of endocrine secretion, there is very little, if any change in metabolism, except that the excess food is converted into fat and stored in the adipose tissue. With a long-continued excessive intake of food the body may lose its power to deal with large amounts of food and then metabolism changes, very often as a result of deficiency of insulin, and diabetes results.

Dietary treatment of obesity

The dietary treatment of obesity is based on the need to reduce the total Calories intake to considerably less than the body's requirements so that the remainder of the Calories required can be derived from the stored fat. in all other respects the diet must be adequate. The general principles of the treatment are thus:

a) To reduce the total Calorie intake by about 50 percent. This usually means a diet of 1,500 or 1,200 Calories, but lower Calories diets may be used in ectreme cases or where the patient is confined to bed.

b) Normal protein requirement must be maintained, i.e., at least 1 gm/kg body weight per day unless there is evidence of need for protein reduction.

c) Adequate mineral and vitamin intake must be ensured. If it is not possible to give all the requirements in food, concentrates may be necessary.

d) The patient must be safeguarded from acute hunger by giving as much bulk in the diet as possible.

e) The aim should be a slow, steady loss of weight over a period of several weeks, or even months.

Excessive and rapid losses of weight will often exhaust the patient and undermine his co-operation.

Reducing diets with low Calorie intake may be used for the treatment of obesity. It is again important to see that the patient has plenty of bulk in the diet by using high fibre foods and low calorie beverages. Concentrated sources of calorie should be avoided.

Dietary treatment for Protein calorie malnutrition

The two common clinical syndromes due to severe protein calorie malnutrition in young children are kwashiorkor and marasmus caused by severe deficiencies of protein and calories in the diet.

The diet should be easily digestible and should contain proteins of high nutritive value e.g., Milk proteins. The calorie intake should be about 1 ½ times the normal requirements i.e. 140 Kcal/kg of body weight for rapid recovery. The protein intake should be about twice the normal protein i.e., 4 to 5 g/kg body weight. The daily requirements of vitamins and electrolytes should be met. If there is

anaemia or Vitamin. A deficiency that should be treated.

QUESTIONS FOR STUDY

1) How is the metabolism of carbohydrate, fat, and protein affected in diabetes mellitus? How does each of these affect the plan of diet for the patient?
2) What special dietary modification would be necessary for the following diabetic patients:

   A child of 7 years; a patient who also has hyperthyroidism; a woman who is 5 months pregnant; a patient who has just had a cholecystectomy?
3) Using the specimen non-vegetarian diet for 1,500 Calories on page **254** divide into proper meals and feedings, stating meal time, for a patient on soluble insulin; for one on long-acting insulin.
4) Plan a similar vegetarian diet for 1,500 Calories.
5) Outline a plan of health teaching for a diabetic patient, stating what methods of teaching you will use.
6) Make a day's plan of feeding for a patient with hyperinsulinism.
7) What are the important principles of a diet for hyperthyroidism or excessive leanness? Explain how these can be carried out in a diet?
8) Select foods to be given in a day's diet for obesity and explain how these will fulfil the requirements of a diet for obesity. What specific foods should be omitted from such a diet?

CHAPTER 6

DIET THERAPY IN CONDITIONS OF THE URINARY SYSTEM

The value of diet in kidney diseases varies greatly. The nature of the disease makes it almost impossible to effect a cure by dietary treatment alone, but temporary or permanent benefit may result from the use of the correct diet.

GENERAL PLAN OF DIETARY TREATMENT

The pathways of metabolism are little changed in kidney diseases, but the diet is usually modified to reduce the substances, which cannot be adequately excreted. The substances to be considered are, water, mineral salts especially sodium chloride, and urea. When the urine is scanty, water and salt cause as much work for the kidney as does protein and should therefore be restricted.

When uraemia occurs, dietary intake of protein is reduced to the minimum, or eliminated entirely for a few days, and a diet high in carbohydrate and sometimes high in fat also is given to reduce the metabolism of protein with the cells. Urea is not, in itself, toxic to the body, but when uraemia occurs there is also usually a loss of liver function, particularly the detoxifying function, and this, combined with loss of kidney function permits the accumulation of other substances which may be toxic to the body. Hence the need to restrict protein intake.

In the majority of kidney diseases the possibilities of feeding vary because the patients may suffer from nausea and vomiting.

The patterns of dietary management for acute and chronic glomerulonephritis, nephrosis, acute anuria and uraemia will be discussed below.

ACUTE GLOMERULONEPHRITIS

In this condition the work of eliminating toxins from the body falls most heavily upon the kidney, leading to irritation, inflammation

and loss of function. This occurs most frequently in children and young adults and is often a result of streptococcal infection of the throat. The patient with this disease may suffer from oliguria (scanty urine), hematuria, uraemia, oedema, nausea and vomiting.

The diet is modified according to the symptoms as summarized below.

Symptom		Dietary Treatment
Oliguria	...	Restriction of fluid
Oedema	...	Restriction of salt
Uraemia	...	Restriction of Protein

Fluid is usually restricted to 1,000-1,200 ml. and may be as low as 500 ml. Salt, or sodium chloride, is usually restricted to 2 gm per day. Very often the quantity of fruit juice used as a part of fluid is also restricted since it contains a considerable amount of potassium. This may upset the mineral balance of the body as much as sodium if the patient is not passing urine. Protein may be reduced to 20 gm per day or less. The protein given should be from complete protein foods and be divided equally between three meals to ensure their maximum utilization. An adequate energy intake of carbohydrate and fat is necessary to provide the minimum Calories required and to reduce the catabolism.

During the acute stage of this illness nausea and vomiting make it impossible to provide adequate dietary intake. Fluids necessary to maintain the fluid balance and provide adequate calories from non protein sources are given mainly as glucose water or glucose with fruit juices if potassium level is not high. When the kidney functions of the patient show signs of recovering, the nausea and vomiting will subside. Easily digested foods with a high carbohydrate content may then be given. Small feedings are encouraged to limited amounts. A moderately Low Protein diet must be continued as long as uraemia is present. Substances such as barley water, and water in which par boiled rice is cooked for a long time is given as they act as mild diurectics.

CHRONIC GLOMERULONEPHRITIS

This condition is often associated with arteriosclerosis and hypertension. The kidney is unable to excrete urea satisfactorily. It also loses its power of concentrating the urine which results in large volumes of urine being passed.

The diet is modified according to the symptoms as summarized below.

Symptom	**Dietary Treatment**
Uraemia	Restriction of protein
Failure of concentrating Power of the kidney	No fluid restriction; quantity of fluid may have to be increased

This condition of the kidney usually continues throughout the life of the patient. The diet should be maintained as normally as possible. Specific factors to be considered are explained below.

Protein intake may be moderately or severely restricted depending on the condition of the patient. It may be given in amounts of 40-60 gm. per day. Excessive protein intake acts as an additional load to the kidney.

Energy intake should be adequate. Sufficient carbohydrate and fat should be taken so that the body's need for energy is met without having the body proteins broken down in order to furnish Calories. Easily digested fats, such as butter, should be given.

Sodium chloride may be given in moderation. However, the intake and output of sodium chloride must be closely observed and balanced. Only the loss due to the large quantities of urine passed should be replaced.

Fluids may be given in amounts of 1-2 litres per day. Additional fluids may be necessary if fever, vomiting or nitrogen retention is present.

NEPHROSIS (Nephrotic Syndrome)

This condition may follow nephritis or may develop without previous history. The urine contains large amounts of albumin. The

loss of protein may be 5-10 gm. per day or even as high as 30 gm. per day. The result of this is a marked fall in plasma protein (hypoproteinaemia) which lowers the osmotic pressure of the blood and causes severe oedema. Nephrosis occurs most frequently in children. The diet is modified according to the symptoms as summarized below.

Symptom		Dietary Treatment
Oedema	...	Restricted sodium
Hypoproteinaemia	...	High protein diet

The patient with this disease will have a normal blood urea. Therefore, a High Protein diet can be given to help in restoring the plasma proteins. A high protein content, 80-100 gm. for a child and 100-120 gm. for an adult, may be given by using fortified milk in addition to the normal diet. For children it may be necessary to concentrate the intake of proteins in the form of custards and ice-cream.

Sodium chloride is restricted for this patient due to severe oedema. Thus, food must be skilfully prepared in order for it to be palatable. It is most essential to encourage the patient to eat. Appetite will usually improve when the oedema is relieved.

Very Low to Moderately Low Protein Diet

General Rules

1) Milk, eggs, meat, and poultry are omitted or restricted according to the prescribed protein intake. When allowed, these should be included in very small quantities at each meal. This will give the most effective mixture of amino acids.

2) Calcium, riboflavin, and iron must be given as supplements.

3) Low Sodium diets should be planned with care in order to make the food palatable.

4) Sugar, boiled sweets, sugar candy, arrowroot and sago could be taken liberally to increase the calorie content.

5) When fluids are restricted, fruit juice can be given in place of

water and other beverages normally used for mealtime.

The chart below shows the food intake for the protein restriction prescribed. The approximate content of calories, carbohydrate and fat is also listed for each diet.

DIETS OF DIFFERENT PROTEIN CONTENTS – DAILY INTAKE

Breakfast:					
Plain tea or coffee					
Milk (ml.)	100	150	150	200	100
Cereal (gm.)	50	50	50	75	75
Fruit (Nos.)	1	1	1	1	1
Egg (Nos.)					1
10 A.M.					
Lime juice with sugar			Lime juice millk 200 ml. No. egg		200ml millk
Lunch					
Rice (gms.)	50 (150)	50	75 (250)	75	100 (300 gm cooked)
Vegetables (2 serving)	2 serving	2 sserving	2 sserving	2 sserving	1 sservings
Curds (ml.)	100	100			
Fruit	1	1	1	1	1
Non-vegetarian		1 portion/ dhal	1 portion/ dhal	1 portion/ dhal	1 portion/ dhal 25 gms.
Sambar Rasam	..	..	1/2 portion	1/2 portion	1 portion
Tea					
Plain tea or coffee;					
Milk (ml.)	100	50	50	100	100
Fruit	1 or sweet	1	1		snack with dhal or biscuits-2

Dinner					
Rice (gms.)	25 (75 gm cooked)	50	50	50	100
Vegetables	2 servings	2 servings	2 servings	2 servings	
Curds			100ml	100ml	100ml
Buttermilk					
Non-vegetarian				1	1
Rasam				portion/ dhal	portion dhal
Fruit (Nos.)					
10 P.M.					
Milk (ml.)		100	200	200	200
Butter or ghee (gm/day)	20	20			
Oil in cooking (gm/day)	15	15	15	20	30
Sugar (gm/day)	100	50	50	30	50
Protein (gm)	20.5	30	40	60	84
K.calories	1580	1550	1635	2000	2500

ACUTE ANURIA

Anuria occurs when there is kidney failure and little or no urine is passed. This results in all water products being retained in the blood. Metabolic changes which occur are uraemia, water and sodium imbalance, and a high potassium level (hyperkalemia). If an artificial kidney is available, it may be used. However, this is rarely available and very expensive. Control of the disease by diet is usually indicated.

When modifying the diet it must be noted that the patient is usually very ill. He will have anorexia, nausea, vomiting and a very poor appetite. Diet therapy should aim at:

a) reducing uraemia

b) avoiding sodium and water retention

c) reducing potassium level in the blood.

Carbohydrates given in amounts of 100-200 gm. per day are fairly effective in reducing tissue catabolism. Fat should be added to increase the daily intake of calories.

Protein is generally avoided when uraemia and anuria are present. When diuresis occurs protein is gradually increased, from 20 gm. to

60 gm. per day depending on the condition of the patient.

The fluid intake must be carefully regulated. Measurement of intake should include the fluid content of foods taken as well as the basic fluids given. A daily intake of 500-700 ml. is usually given.

The amount of fluid may be increased with improvement of the condition of the patient.

Potassium is avoided as much as possible. Adequate calorie intake is given by adding carbohydrates and fats. This helps to prevent catabolism and a rising level of potassium in the blood.

A diet that is free from protein, sodium and potassium does not permit a wide choice of foods.

These are limited to white sugar, glucose, salt-free butter, cornflour, sago and arrowroot and flavourings. Sugar candy helps to increase the calories when the patient is able to eat it. A mixture of butter, sugar, starch, and water, as chosen from the daily allowances, can be cooked in the form of a thick soup and flavouring added. All necessary Calories can be provided by giving this mixture by mouth in 5 or 6 feedings per day. If it is necessary to use tube feedings for the provision of Calories, an emulsion of sugar and butter may be used.

All of the above dietary restrictions are extremely severe and may be difficult for the very ill patient to eat and to accept. He must be given encouragement and be assured of the necessity of this type of diet.

URAEMIA

Uraemia is a condition in which the nitrogen retention in the blood is above normal. The diet must be adjusted by changing the protein and fluid intake according to the excretory functioning of the kidney. The diet usually prescribed is low in protein and sodium. The fluid intake is adjusted according to the output.

The type of diet taken by the patient will depend on his ability to eat and retain it. Carbonated beverages and plain tea and coffee with sugar are usually tolerated best. Fruit juices must be restricted when the potassium level is high.

URINARY INFECTIONS

The treatment of cystitus and pyelitis is mainly by medication and rest. Diet alone is of little value but along with the other treatment prescribed, the following points should be noted.

1) Fluid intake should not be less than 2,500 ml. per day.
2) Diet should be light and bland, but well balanced.
3) Condiments and spices should be omitted because of their irritating effect on the renal tract.

QUESTIONS FOR STUDY

1) In what way do the kidneys fail to function in acute gtomerulo-nephritis? Because of this what modification of diet is necessary?
2) Explain why oedema results in many kidney conditions and how dietary treatment can help to reduce it.
3) Under what conditions is it necessary to restrict protein and when is high protein diet necessary? What is the danger in severe protein restriction for any length of time?
4) How can a salt free diet be made more tasty? Suggest some preparations and how to modify them.
5) What are the signs of recovery of kidney function in acute nephritis which indicate that dietary additions may be made? What new foods can be added to the diet?

CHAPTER 7

DIET THERAPY IN CONDITIONS OF THE CIRCULATORY SYSTEM

Heart disease affects people of all ages, but it is most frequent in those of middle age and is most often caused by atherosclerosis. Diseases of the heart may affect:

1) The pericardium or outer covering of the heart.
2) The endocardium or membranes lining the heart or
3) The myocardium or the heart muscle.

In addition, the blood vessels within the heart or those leaving the heart or the heart valves may be diseased.

Cardiac disease may be classified according to the type of disorder; acute or chronic, compensated or decompensated.

ACUTE CARDIAC DISEASE

Acute cardiac disease occurs in certain acute infections which lead to endocarditis and cardiac failure. The objective of diet therapy is to rest the heart as much as possible. Initially, a liquid or semi-solid diet is given in small frequent feedings. The *Karrell Diet* is a regimen which is often used during the initial stages of treatment. It consists of 800 ml. of milk given daily in four feedings of 200 ml. each.

This provides 600 Calories and 30 gm of Protein. Because of itss inadequacy it is used for only three to four days after which toast, eggs, soup, fruit and soft well-pureed foods are introduced as the condition of the patient improves.

CHRONIC CARDIAC DISEASE

In chronic cardiac disease the condition may be either compensated or decompensated. When compensated, the heart is able to maintain adequate circulation to all parts of the body. When decompensated, the heart is unable to maintain adequate circulation to the tissues.

Modification of the diet is based on the following objectives:

1) To rest the heart as much as possible.
2) To maintain good nutrition.
3) To eliminate oedema.
4) To provide a diet acceptable to the patient.

When planning the Calories requirement for this patient it must be remembered that overweight is undesirable. A gradual weight reduction is recommended for the obese patient in order to reduce the work of the heart. A slight degree of under weight (10 percent) is even recommended for those who are not obese. A patient who is in bed will not require more than 1,000-1,200 Calories per day. This may be gradually increased to 1,500-1,800 Calories as the condition of the patient improves. A large part of the diet should be made up of carbohydrate.

A low normal intake of Protein is recommended, starting from 40 gm. and gradually increasing to 60 gm. per day. The slightly reduced protein content is recommended because protein has a stimulating effect on metabolism which increases the demands made upon the heart. This is called *specific dynamic action*.

Sodium is generally restricted. The degree of restriction depends on the condition of the patient.

Fluids are not usually restricted because the amount of sodium is carefully controlled in order to eliminate oedema.

When planning the consistency and amount of food for this patient, small feedings given at frequent intervals are preferable. This is done to prevent additional strain on the heart. Liquid to semi-solid bland foods should be given according to the ability of the patient to chew. Constipation and straining can be avoided by a wise choice of fruits and vegetables. Foods that cause gas formation should be avoided. Individual tolerance for these foods will vary.

In compensated heart disease dietary modifications may not have to be made. This depends to a great extent however, on the degree of injury to the heart. Gradual weight reduction is essential if the patient is overweight. Milk sodium restriction may be recommended in order

to control and prevent oedema.

The patient with decompensated heart disease in often too ill to eat; rest is the most important requirement. The diet is usually limited to fruit juice with sugar and water. Gradually, as the condition of the patient improves, soft, pureed, bland foods are given in small quantities as tolerated. Sodium is severely restricted during this period. The foods are pureed to eliminate chewing which is an additional effort for the patient. He may also have to be fed for the same reason. A semi-solid diet given in small frequent feedings may be introduced as the patient improves. A diet of regular consistency is allowed only when the patient is able to feed himself and can chew without excessive strain. The general modifications mentioned above may be followed.

Sodium restricted diet

The foods in a full normal diet contain approximately 2-3 gm of sodium chloride before any further addition is made in the daily preparation. A liberal intake of food to which salt has been added will increase the sodium intake. (The words, 'salt' and 'sodium' may be used interchangeably.) the retention of sodium in the body has been found to be the most important factor causing oedema.

There are many degrees of sodium restriction depending on the severity of the condition of the patient. Formerly these diets were referred to as

1) Low salt diet with no salt added at the table. Or,

2) Salt-free diet with no salt added in cooking or at the table.

The values available for the sodium content of foods in India are not yet complete. However, it is possible to group the sodium restricted diets as follows:

1) Moderately Low Sodium diet (approximately 2,000-4000 mg of sodium) which is usually ordered for the patient with a moderate amount of heart injury. A limited amount of salt (1-2 gm) may be used in cooking, but no salt is added after cooking. Foods to be omitted are listed below.

2) Low Sodium diet (approximately 600-1,200 mg of sodium) which is usually prescribed for cardiac patients who have oedema. Salt is eliminated both in cooking and on the table. The list of foods to be omitted is strictly followed.

3) Sodium may be prescribed to give .5-1 gm of sodium chloride to the patient, and this is used carefully in his foods for the day.

4) Very Low Sodium diet (approximately 500 mg of sodium or less) which is prescribed for patients with congestive cardiac failure, severe oedema, ascites or hypertension. No salt is added either during preparation of the food or at the table. Severe restrictions of foods such as milk and meat are also followed. Low sodium milk may be used when it is available, but not more than two cups per day. If this is not available, whole skimmed milk or half the amount of whole milk may be used.

A list of foods to be avoided in sodium restricted diets is given below.

FOODS HIGH IN SODIUM

1) Salt
2) Baking powder
3) Bicarbonate of soda
4) Canned foods
5) Cheese
6) Bacon, Ham, Sausages
7) Meat and yeast extracts like Marmite
8) Salted chips, Nuts, Popcorn & Biscuits
9) Pappads ---all varieties
10) Commercial Salad Dressings and Sauces
11) Soft Drinks containing sodium benzoate
12) Soup cubes

13) Proprietary drinks ---Bournvita and chocolate drinks.

Most patients find it very difficult to adjust to taking food without salt. The necessity of the restriction should be carefully explained, and every attempt should be made to make the food palatable.

The careful use of tomato juice, lime juice, sugar, mint, cloves, cinnamon, cardamom, pepper, ginger, tamarind, and curds helps to add a different flavour. Vanilla and almond falvourings may also be used to make the food more palatabale.

Health teaching related to the diet of the patient should include a knowledge of hidden source of sodium such as in the processing of fish, meat and fruits. The sodium content of drinking water should also be included in this. Salt substitutes may be used with the approval of the doctor.

HYPERTENSION

Hypertension develops when, for some reason, there is increased resistance to the normal circulation of blood. This may be temporary, as the result of exercise, emotion, pregnancy, or menopause; it may be permanent, associated with artherosclerosis, cardiac failure or chronic kidney disease.

Diet therapy is advised when the patient is over weight or when hypertension is accompanied by oedema or severe headache. With the discovery of anti-hypertension medicines, generally speaking, a moderate intake of all foods is advised for mild hypertension. Low sodium diets should be strictly followed when ordered as a part of the diet therapy.

Kempner's Rice Diet has been used with some success, though it is not used as frequently as before. The success of this diet is due more to the low sodium content than to the low protein content. It consists of only rice, fruit and sugar in the following quantities:

Rice : 270-360 gm dry weight, steamed or boiled in plain water or fruit juice without the addition of salt. Distilled water must be used if the sodium content of tap water is high.

MINERAL AND TRACE ELEMENTS: COMMON FOODS

All values are mg. Per 100 gms. of edible portion.

Sl.No. (1) Name of the foodstuff (2)	Mg. (3)	Sod. (4)	Pot. (5)	Cu. (6)	Mn. (7)	Mo. (8)	Zn. (9)	Cr. (10)	S. (11)	CI (12)
CEREAL GRAINS AND PRODUCTS										
1. BAJRA	137	10.9	307	1.06	1.15	0.069	3.1	0.023	147	39
2. BARLEY	21	—	—	1.19	1.03	—	1.2	0.016	130	91
3. ITALIAN MILLET	81	4.6	250	1.40	0.60	0.070	2.4	0.030	171	37
4. JOWAR	171	7.3	131	0.46	0.78	0.039	1.6	0.008	54	44
5. MAIZE, dry	139	15.9	286	0.41	0.48	0.038	2.8	0.004	114	33
6. MAIZE, tender	40	51.7	151	—	—	—	—	—	61	34
7. PANIVARAGU	153	8.2	113	1.60	0.60	—	1.4	0.020	157	19
8. RAGI	137	11.0	408	0.47	5.49	0.102	2.3	0.028	160	44
9. RICE, paraboiled hand pounded	157	—	—	0.24	1.10	0.078	1.4	0.009	—	—
10. RICE, paraboiled milled 5%	91	—	—	0.17	0.80	0.068	1.4	0.006	—	—
11. RICE, parboiled milled 10%	61	—	—	0.17	0.66	0.054	1.3	0.005	—	—
12. RICE, milled 5%90	—	—	0.14	0.59	0.058	1.4	0.004	—		—
13. RICE, milled 10%	64	—	—	0.07	0.51	0.045	1.3	0.003	—	—
14. RICE, flakes	101	10.9	154	0.37	—	—	—	—	105	17
15. SAMAI	133	8.1	129	1.00	0.68	0.016	3.7	0.180	149	13
16. SANWA MILLET	82	—	—	0.60	0.96	—	3.0	0.090	—	—
17. VARAGU	147	4.6	144	1.60	1.10	—	0.7	0.020	136	11

18.WHEAT, bulgar (parboiled)	144	4.5	260	0.56	—	—	—	—	143	22
19.WHEAT, whole	138	17.1	284	0.68	2.29	0.051	2.7	0.012	128	47
20.WHEAT, flour(whole)	132	20.0	315	0.51	2.29	0.039	2.2	0.006	122	29
21.WHEAT, flour(refined)	54	9.3	130	0.21	0.62	0.011	0.6	0.001	115	47
22.WHEAT, semolina	—	21.0	83	—	—	—	—	—	—	—
23.WHEAT, vermicelli	42	7.9	138	0.29	—	—	—	—	145	46
PULSES AND LEGUMES										
24. BENGAL GRAM, whole (desi)	119	37.3	808	1.18	1.21	0.154	6.1	0.008	179	58
25.BENGAL GRAM,whoel (kabuli)	169	—	—	1.01	0.74	—	2.9	0.032	—	—
26.BENGAL GRAM, dhal	130	73.2	720	1.34	1.05	0.195	1.7	0.001	160	39
27. BLACK GRAM,whole	154	—	—	1.05	1.01	0.810	3.3	0.012	—	—
28.BLACK GRAM, dhal	130	39.8	800	0.93	0.96	0.425	3.0	0.012	174	9
29.COW PEA	210	23.2	1131	0.87	1.34	1.890	4.6	0.029	165	10
30.GREEN GRAM, whole	127	28.0	843	0.39	2.47	0.304	3.0	0.014	188	12
31.GREEN GRAM, dhal	122	27.2	1150	0.39	1.02	0.446	2.8	0.010	214	25
32.HORSE GRAM	156	11.5	762	1.81	1.57	0.749	2.8	0.024	181	8
33.KHESARI, dhal	92	37.7	644	0.77	—	—	—	—	144	36
34.LENTIL, whole	80	40.1	629	1.87	1.04	0.171	2.8	0.024	104	19
35.LENTIL, dhal	74	—	—	1.37	0.81	—	3.1	0.020	—	—
36.MOTH BEANS	225	29.5	1096	0.85	—	—	—	—	180	9
37.PEAS, green	34	7.8	79	0.23	—	—	—	—	95	20
38.PEAS, dry	100	20.4	725	1.29	0.58	0.638	2.3	0.032	189	59
39.PEAS,roasted	122	14.7	750	1.32	—	—	—	—	200	73
40.RAJMAH	184	—	—	1.45	1.60	—	4.5	0.029	—	—
41.RED GRAM, whole	86	—	—	1.23	0.96	0.222	3.1	0.010	—	—
42.RED GRAM, dhal90	28.5	1104	1.20	0.69	0.283	0.9	0.001	177	5	

43.RED GRAM, tender	58	93.0	463	0.40	—	—	—	—	494	22
44.SOYA BEAN (black)	238	—	—	1.38	2.35	—	4.4	0.029	—	—
45.SOYA BEAN (white)	175	—	—	1.12	2.11	—	3.4	0.028	—	—
LEAFY VEGETABLES										
46.AMARANTHUS, GAMGETICUS	122	230.0	341	0.08	0.36	0.130	0.18	0.007	61	88
47.AMBAT CHUKA	123	—	—	0.04	0.40	—	0.27	0.006	—	—
48.BETAL LEAVES	447	—	—	2.32	4.47	—	3.44	0.137	—	—
49.BRUSSELS SPROUTS	26	7.9	477	0.07	—	—	—	—	212	2
50.CABBAGE	31	—	—	0.02	0.18	0.078	0.30	0.005	—	—
51.CELERY LEAVES	52	35.5	210	0.30	—	—	—	—	102	19
52.COLOCASIA LEAVES	32	—	—	0.18	—	—	—	0.011	—	72
53.CORIANDER LEAVES	31	58.3	256	0.14	0.50	1.120	0.32	0.014	49	43
54.CURRY LEAVES	44	—	—	0.10	0.15	—	0.20	0.006	81	198
55.DRUM STICK LEAVES	42	—	259	0.07	0.37	—	0.16	0.010	137	423
56.FENUGREEK LEAVES	33	76.1	31	0.10	0.23	0.400	0.36	0.006	167	165
57.GOGU	66	—	—	0.08	0.30	—	0.27	0.005	60	19
58.LETTUCE	30	58.0	33	0.08	—	—	—	—	27	23
59.MINT	60	—	—	0.18	0.57	—	0.44	0.008	84	34
60.PARUPPU KEERAI	120	67.2	716	0.19	—	—	—	—	63	73
61.PONNANGANNI	46	—	—	0.19	0.46	—	—	—	13	—
62.RADISH LEAVES	22	—	—	0.02	0.01	—	0.08	0.002	—	—
63.SAFFLOWER LEAVES	51	126.4	181	0.22	—	—	—	—	—	235
64.SPINACH	64	58.5	206	0.10	0.56	0.010	0.30	0.005	30	54
65.TAMARIND LEAVES, tender	26	—	—	0.02	0.12	—	0.26	0.009	63	94
ROOTS AND TUBERS										
66.ARROW ROOT flour	—	30.0	20	—	—	—	—	—	—	—
67.BEET ROOT	9	59.8	43	0.29	0.19	—	0.91	0.012	14	24

68.CARROT	17	35.6	108	0.10	0.16	—	0.36	0.017	27	13
69.COLOCASIA	28	9.0	550	0.18	0.28	—	0.31	0.005	—	—
70.ONION, (big)	16	4.0	127	0.18	0.18	0.030	0.41	0.009	—	—
71.POTATO	30	11.0	247	0.16	0.13	0.070	0.53	0.007	37	16
72.RADISH, pink	196	63.5	10	0.07	0.15	—	0.68	0.009	—	—
73.RADISH, white	—	33.0	138	0.40	—	—	—	—	—	—
74.SWEET POTATO	27	9.0	393	0.02	0.22	—	0.11	0.006	—	—
75.TAPIOCA, chips dried	66	7.5	764	0.15	—	—	—	—	58	10
76.YAM, ORDINARY	17	9.0	237	0.12	0.12	—	0.45	0.016	—	—
77.YAM, WILD	34	11.0	450	0.16	—	—	—	—	35	29
OTHER VEGETABLES										
78.BITTER GOURD (white)	36	17.8	152	0.10	0.08	—	0.46	0.005	15	8
79.BITTER GOURD (green)	33	2.4	171	0.09	0.008	—	0.39	0.005	21	8
80.BOTTLE GOURD26	1.8	87	0.03	0.06	—	0.22	0.046	10	5	
81.BRINJAL	15	3.0	200	0.12	0.13	—	0.22	0.007	44	52
82.BROAD BEANS	33	43.5	39	0.17	—	—	—	—	53	43
83.CAULIFLOWER	18	53.0	138	0.13	0.10	—	0.40	0.003	231	34
84.CLUTSTER BEANS	47	—	—	0.08	0.10	—	0.36	0.004	—	—
85.CUCUMBER	14	10.2	50	0.09	0.14	0.070	0.23	0.002	17	15
86.DRUM STICK	28	—	259	0.01	0.05	—	0.16	0.003	137	423
87.FIELD BEANS, tender	174	55.4	74	0.10	0.12	—	0.40	0.004	40	31
88.FRENCH BEANS	38	4.3	120	0.06	0.12	0.020	0.42	0.006	37	10
89.GIANT CHILLES	12	—	—	0.12	0.06	—	0.13	0.006	—	—
90.JACK, tender	—	35.0	328	—	—	—	—	—	—	—
91.JACK FRUIT, seeds	54	63.2	246	0.19	—	—	—	—	356	14
92.KOVAI	36	—	—	0.07	0.22	—	0.26	0.004	—	—
93.KNOL-KHOL	33	112.0	37	0.05	0.11	—	0.24	0.019	143	67
94.LADIES FINGERS	53	6.9	103	0.11	0.15	—	042	0.005	30	41

95.LOTUS STEM, dry	168	438.0	3007	1.22	—	—	—	—	258	444
96.MANGO, green	16	43.0	83	0.03	0.07	—	0.07	0.050	15	2
97.ONION STALKS	104	2.2	109	0.45	0.74	—	2.29	0.039	33	7
98.PAPAYA, green	—	23.0	216	—	—	—	—	—	—	—
99.PARWAR	9	2.6	83	1.11	—	—	—	—	17	4
100.PINK BEANS	—	32.2	117	0.13	—	—	—	—	182	47
101.PLAINTAIN, flower	54	20.1	185	0.10	—	—	—	—	68	68
102.PLAINTAIN, green	13	15.0	193	0.03	0.30	—	0.05	0.004	15	6
103.PUMPKIN, fruit	38	5.6	139	0.05	03.05	—	0.26	0.005	16	4
104.RIDGE GOURD	32	2.9	50	0.08	0.07	—	0.38	0.003	14	7
105.SNAKE GOURD	28	25.4	34	0.27	0.14	—	0.31	0.004	35	21
106.SWORD BEANS	—	29.0	1800	—	—	—	—	—	—	—
107.TINDA, tender	14	35.0	24	0.12	—	—	—	—	—	44
108.TOMATO, green	15	45.8	114	0.19	—	—	—	—	24	38
109.VEGETABLE MARROW	13.0	27.3	94	0.22	—	—	—	—	11	9
110.WATERCHEST NUT, fresh	72	—	—	1.31	0.85	—	1.56	0.011	—	—
NUTS AND OIL SEEDS										
111. ALMOND	373	—	—	0.97	1.88	—	3.57	0.161	—	—
112.ARECANUT (raw)	66	—	—	0.92	1.46	—	0.81	0.473	—	—
113.ARECANUT (processed)	83	—	—	2.54	2.83	—	1.30	0.386	—	—
114.CASHEW NUT	349	—	—	1.66	1.42	—	5.99	0.163	—	—
115.COCONUT, dry	—	—	—	1.00	6.24	0.021	5.00	—	—	—
116.COCONUT, meal deoiled	355	72.5	2003	—	—	—	—	—	431	374
117.GARDEN CRESS SEEDS	430	—	—	—	—	—	—	—	1	41
118.GINGELLY SEEDS	—	—	—	2.29	1.32	0.204	12.20	0.087	—	—
119.GROUNDNUT	—	—	—	0.90	1.10	0.166	3.90	0.048	—	—
120.MUSTARD SEEDS	—	—	—	0.83	2.56	0.089	4.80	0.063	—	—

121.PIYAL SEEDS	373	10.2	436	086	—	—	—	—	186	25
122.SAFFLOWER SEEDS	—	—	—	1.58	1.10	0.054	5.20	0.045	—	—
123.WALNUT	302	—	—	1.67	2.62	—	2.32	0.101	—	—
CONDIMENTS AND SPICES										
124.ASAFOETIDA	80	—	—	0.43	1.12	—	0.83	0.079	—	—
125.CARDAMOM	173	—	—	0.47	8.92	—	2.81	0.031	—	—
126.CHILLIES, dry	—	14.0	530	—	—	—	—	—	—	—
127.CHILLIES, green	272	—	—	1.40	1.38	0.070	1.78	0.040	—	—
128.CLOVES, dry	130	—	—	1.01	4.75	—	1.47	0.056	—	—
129.CORIANDER SEEDS	239	32.0	990	1.01	1.67	—	3.26	0.050	—	—
130.CUMIN SEEDS	475	126.0	980	0.71	1.02	—	2.66	—	—	—
131.FENUGREEK SEEDS	124	19.0	530	0.71	1.03	—	3.08	0.064	—	—
132.GARLIC, dry	71	—	—	0.63	0.86	—	1.93	0.020	—	—
133.GINGER, fresh	405	—	—	0.74	5.56	—	1.93	0.057	—	—
134.GINGER, dry (sonti)	187	—	—	0.33	12.91	—	0.82	0.144	—	—
135.MACE	213	—	—	1.56	1.54	—	1.26	0.039	—	—
136.NUT MEG, fruit229	—	—	0.71	1.78	—	1.22	0.234	—		—
137.OMUM	141	—	—	0.96	3.40	—	4.52	0.057	—	—
138.PEPPER, DRY (black)	171	—	—	1.42	4.14	—	1.31	0.074	—	—
139.POPPY SEEDS (khas khas)	257	—	—	0.63	4.31	—	4.34	0.108	—	—
140.TAMARIND PULP	41	—	—	0.20	0.55	—	—	0.056	—	—
141.TURMERIC	278	—	—	0.39	8.38	—	2.72	0.069	—	—
FRUITS										
142.AMLA	—	5.0	225	—	—	—	—	—	—	—
143.APPLE	7	28.0	75	0.10	0.14	—	0.06	0.008	7	1
144.APRICOTS, fresh	—	—	430	0.11	—	—	—	—	—	—
145.BAEL FRUIT	—	—	600	0.21	—	—	—	—	—	—

146.BANANA, ripe	41	36.6	88	0.16	0.20	—	0.15	0.004	7	8
147.BILIMBI	—	—	130	0.05	—	—	—	—	—	—
148.CAPE GOOSBERRY	31	0.9	320	0.19	—	—	—	—	43	12
149.CHERRIES, red	27	—	320	0.08	0.08	—	0.33	0.005	—	—
150.DATES, fresh	12	—	—	0.05	0.03	—	0.03	0.004	—	—
151.GRAPES, pale green variety	82	—	—	0.20	0.11	—	0.10	0.007	—	—
152.GUAVA, country	24	5.5	91	0.14	0.14	—	0.16	0.009	14	4
153.JACK FRUIT, ripe	24	—	—	0.12	0.006	—	0.07	0.013	69	9
154.JAMBU FRUIT	39	26.2	55	0.07	0.15	—	0.16	0.005	13	8
155.KORUKKEPALLI	40	37	377	0.60	—	—	—	—	109	51
156.LEMON	19	—	270	0.06	0.07	—	0.07	0.007	—	—
157.LEMON SWEET	—	—	210	0.11	—	—	—	—	—	—
158.LICHI	10	124.9	159	0.30	—	—	—	—	19	3
159.LIME sweet, malta	—	—	170	0.51	—	—	—	—	—	—
160.LIME sweet, mosambi	—	—	490	0.17	—	—	—	—	—	—
161.LOQUAT	—	—	390	0.13	—	—	—	—	—	—
162.MANGO, ripe	270	26.0	205	0.11	0.13	—	0.27	0.006	17	3
163.MELON. musk	31	104.6	341	0.03	—	—	—	—	32	80
164.MELON, water	13	27.3	160	0.05	—	—	—	—	42	21
165.ORANGE	9	4.5	9.3	0.58	—	—	—	—	7	5
166.PAPAYA, ripe	11	6.0	69	0.20	—	—	—	—	13	11
167.PEACHES	21	2.0	453	0.06	—	—	—	—	26	0
168.PEARS	7	6.1	96	0.40	—	—	—	—	14	1
169.PHALSA	72	4.4	351	0.12	—	—	—	—	13	86
170.PINE APPLE	33	34.7	37	0.13	0.56	—	0.11	0.011	20	13
171.PLUMS	147	0.8	247	0.13	—	—	—	—	33	0
172.POMEGRANATE	44	0.9	133	0.34	0.77	—	0.82	0.022	12	2
173.ROSE APPLE	4	34.1	50	0.01	—	—	—	—	13	4
174.SAPOTA	25	5.9	269	0.08	0.68	—	0.16	0.008	17	26
175.SEETHUPHAL	84	—	—	0.43	0.64	—	0.80	0.026	—	—

176.TOMATO, ripe	—	12.9	146	0.19	0.26	—	0.41	0.015	11	6
177.TOMATILLO	23	0.4	243	0.09	—	—	—	—	27	14
178.TREE TOMATO	34	1.7	539	0.17	—	—	—	—	37	10
179.WOOD APPLE	41	—	—	0.21	0.18	—	0.46	0.006	—	—
180.ZIZYPHUS	13	—	—	0.12	0.17	—	0.10	0.007	—	—
FISHES AND OTHER SEA FOODS										
182.AIR	—	—	—	0.06	—	—	—	—	—	—
183.BACHA	—	—	—	0.11	—	—	—	—	—	—
184.BAM	—	—	—	0.06	—	—	—	—	—	—
185.BATA, small varieties	—	—	—	0.17	—	—	—	—	—	—
186.BHEKTI	—	66.0	173	0.11	—	—	—	—	—	—
187.BHOLA	—	—	—	0.05	—	—	—	—	—	—
188.BOAL	—	—	—	0.08	—	—	—	—	—	—
189.CHELA, dried	—	—	—	0.51	—	—	—	—	—	—
190.CHINGRI, goda dried	—	—	—	1.40	—	—	—	—	—	—
191.CHITAI	—	34.0	119	0.17	—	—	—	—	—	—
192.HILSA	—	52.0	183	0.14	—	—	—	—	—	—
193.KATLA	—	50.0	151	0.12	—	—	—	—	—	—
194.KHORSULA	—	—	—	0.13	—	—	—	—	—	—
195.KOI	—	64.0	195	0.16	—	—	—	—	—	30
196.MAGUR	—	58.0	147	—	—	—	—	—	—	—
197.MAHASOLE	—	—	—	0.12	—	—	—	—	—	—
198.MRIGAL	—	—	—	0.12	—	—	—	—	—	—
199.PABDA	—	—	—	0.09	—	—	—	—	—	—
200.PANGAS	—	—	—	0.05	—	—	—	—	—	—
201.PARSEY, fresh	—	—	—	0.14	—	—	—	—	—	—
202.PRAWN	—	66.0	262	—	—	—	—	—	—	—
203.ROHU	13	101.0	288	0.13	—	—	—	—	103	3
204.SARPUTI	—	—	—	0.08	—	—	—	—	—	—
205.SINGHI	—	53.0	223	0.15	—	—	—	—	—	—

206.SOLE	—	—	—	0.11	—	—	—	—	—	—
207.TAPRA, dried	—	—	—	0.71	—	—	—	—	—	—
208.TAPSI, dried	—	—	—	1.20	—	—	—	—	—	—
209.TENGRA, dried	—	—	—	0.58	—	—	—	—	—	—
MEAT AND POULTERY										
210.BEEF MUSCLE	—	52.0	214	—	—	—	—	—	—	—
211.LIVER GOAT	—	73.0	160	—	—	—	—	—	—	—
212.MUTTON, muscle	—	33.0	270	—	—	—	—	—	—	—
MILK AND OTHER PRODUCTS										
213.MILK buffalo's	—	19.0	90	—	—	—	—	—	—	—
214.MILK, cow's	—	73.0	140	—	—	—	—	—	—	—
215.MILK, goat's	—	11.0	110	—	—	—	—	—	—	—
216.CURD (COW'S MILK)	—	32.0	130	—	—	—	—	—	—	—
BEVERAGES (ALCOHOLIC)										
217.PACHWAI (assam)	51	—	110	—	—	—	—	—	25	—

MINERAL AND TRACE ELEMENTS: LESS FAMILIAR FOODS

All values are mg. per 100 gms. of edible portion.

Sl.No. Name of the foodstuff (1) (2)	Mg. (3)	Sod. (4)	Pot. (5)	Cu. (6)	Mn. (7)	Mo. (8)	Zn. (9)	Cr. (10)	S. (11)	CI (12)
CEREAL GRAINS AND PRODUCTS										
218.BAMBOO SEEDS	32	91.0	—	0.19	—	—	—	—	—	76
219.BUCK WHEAT	227	16.2	362	0.17	—	—	—	—	148	6
220.CHENOPODIUM ALBUM SEEDS	292	—	—	0.52	2.13	0.067	2.43	—	—	—
221.RAJKEERA SEEDS	351	—	—	0.63	—	—	—	—	174	9
222.GOA BEANS (WHOLE)	269	—	—	1.04	3.30	—	3.0	0.029	—	—
LEAFY VEGETABLES										
223.NEEM LEAVES, TENDER	127	72.2	254	0.60	—	—	—	—	96	26
224.SONCHAL SAG	—	680	—	0.39	—	—	—	—	—	—
225.SOYA LEAVES	57	—	—	0.09	0.45	0.439	—	0.012	—	—
NUTS AND OILSEEDS										
226.JÜNGLI BADAM	274	—	517	0.82	—	—	—	—	122	12
227.BAJJAR BHANG	405	—	—	—	—	—	—	—	—	23
228.THAVITUU PAZHAM	30	7.7	106	0.15	—	—	—	—	30	19
229.VIKKI PAZHAM	37	3.9	435	0.08	—	—	—	—	68	85

RECOMMENDED DIET -RECOMMENDED

Group	Particulars	Body wt	Net energy	Protein	Fat	Cal-cium	Iron	Vit. A. Ug/d Reti
		kg	kcal/d	g/d	g/d	mg/d	mg/d	nol
Man	sedentary work			2425				
	Moderate work		60	2875	60	20	400	28
	Heavy work		3800					
Woman	Sedentary work		/	1875				
	Moderate work		50	222,5	50	20	400	30
	Heavy work		2925					
	Preganat woman		50	+300	+15	30	1000	38
	Location							
	0-6 months	50	+550	+25	45	1000	30	950
	0-12 months		+400	+18				
Infants	0-6months	5.4	108/kg	2.05/kg			500	
	6-12 months	8.6	98/kg	1.65/kg				
Children	1-3 years	12.2	1240	22			12	400
	4-6 years	19.0	1690	30	25	400	18	400
	7-9 years	26.9	1950	41			26	600
Boys	10-12 years	35.4	2190	54	22	600	34	600
Girls	10-12 years	31.5	1970	57			19	
Boys	13-15 years	47.8	2450	70	22	600	41	600
Girls	13-15 years	46.7	2060	65			28	
Boys	16-18 years	57.1	2640	78	22	500	50	600
Girls	16-18 years	49.9	2060	63			30	

DIETARY ALLOWANCE FOR INDIANS

Thia-	Ribo-	Nico-	Pyri-	Ascor-	Folic	Vit.		
B-caro	min	flavin	tinic	doxin	bic	acid	B12	
			acid		acid			
tene	mg/d	mg/d	mg/d	mg/d	mg/d	ug/d	ug/d	
		1.2	1.4	16				
600	2400	1.4	1.6	18	2.0	40	100	1
	1.6	1.9	21					
		0.9	1.1	12				
600	2400	1.1	1.3	14	2.0	40	100	1
	1.2	1.5	16					
600	2400	+0.2	+0.2	+2	2.5	40	400	1
	+0.3	+0.3	+4					
3800	+0.2	+0.2	+3	2.5	80	150	1.5	
		55mg/kg	65mg/kg	710mg/kg	0.1			
350	1200	50mg/kg	60mg/kg	650mg/kg	0.4	25	25	0.2
1600	0.6	0.7	8	0.9		30		
	0.9	1.0	11		40	40	0.2-1.0	
2400	1.0	1.2	13	1.6		60		
2400	1.1	1.3	15	1.6	40	70	0.2-1.0	
	1.0	1.2	13					
2400	1.2	1.5	16	2.0	40	100	0.2-1.0	
	1.0	1.2	14					
2400	1.3	1.6	17	2.0	40	100	0.2-1.0	
	1.0	1.2	14					

Fruit: All kinds of fruit and juices may be used, except dried fruits and nuts, and preservative. Not more than one banana should be allowed daily.

Sugar: White sugar or dextrose, 100-150 gm per day. In this diet the food value is:

Calories	...	not less than 2,000
Protein	...	approximately 20 gm per day
Fat	...	not more than 5 gm
Carbohydrate	...	470 gm or more
Sodium	...	not more than 150 mg.
Chlorine	...	not more than 200 mg.

The total fluid content per day as fruit juice and in cooking is restricted to 700-1,000 ml.

Of the other essential nutrients, vitamin C only is present in adequate amounts, so that Vitamins A and D, thiamine, riboflavin, nicotinic acid and Calcium panthothenate must be added as concentrates.

Food Allowed	Food Avoided
Milk	
Skimmed milk, butter milk, non-fat dry milk	Whole milk with fat, curds with high fat content, condensed milk
Cheese	
Cottage cheese (uncreamed)	Cream and hard cheese
Egg	
White – no restrictions Yolk – 2-3 per week	More than recommended
Meat and Fish	
Lean meat and fish with visible fat trimmed	Duck, goose, pork, sausages, canned meats, meat or fish with high fat content

Dhals, Lentils, Nuts		
	No restriction except on low calorie diets, peanut butter	....
Fats		
	Corn oil, saffola oil, ground nut or gingelly oil	Coconut oil, ghee, butter, cream, vanaspathy, margarine
Cereals		
	All depending on calorie restrictions	....
Vegetables		
	All except on reducing diet where potatoes and double beans may be restricted	....
Bread		
	Any variety without butter, ghee or vanaspathy	Commercial biscuits, pastries, puffs made from saturated fat
Fruit		
	All depending on calorie restrictions	Coconut, olives
Desserts		
	Jelly, gelatine, angel food cake	Ice-cream, custard, chocolates
Beverages		
	Coffee, tea, unsweetened carbonated	....
Misc.		
	Sugar, honey, syrup, pickles, relishes	Fried chips

Anaemia

The condition may be caused by:

1) Loss of blood as in haemorrhage or destruction of blood cells caused by poisons or infections.

2) Imperfect blood formation due to

(a) lack of necessary nutrients,

(b) damage to the bone marrow which produces red blood cells.

Poor nutrition may be an important cause, either by failure to provide essential nutrients like iron protein or by failure of the body to absorb some essential nutrient like Vitamin B.

Treatment of anaemia must then be twofold, (a) removing the cause, (b) providing necessary nutrients for the formation of new blood cells or haemoglobin. On pages **126-133** of the section on the Science of Nutrition are listed the nutrients essential for the normal development of red blood cells and their function.

In some cases iron is the most important nutrient that needs to be provided. In iron-deficiency anaemia which is largely secondary, iron may be lacking because of loss of iron from the body in haemorrhage.

Whatever the cause, the treatment is largely the giving of iron in food or in drugs or both.

Frequently associated with the lack of iron is the lack of protein from which haemoglobin may be produced and of other nutrients mentioned before.

1) Include daily: 1 serving of dried fruit like raisins, dates.
2) Use cereals which are whole grain and not finely milled.
3) Include weekly: 1 or 2 servings liver, kidney, heart and 2 or more servings of pulses like dhal.
4) Use plenty of jaggery and green leafy vegetables daily.
5) Provide high protein diet, including milk, eggs, meat, fish.

QUESTIONS FOR STUDY

1) Why is obesity a problem in cardiac disease?
2) What modifications are necvessary in each of the following for diet in cardiac failure: (a) Calorie content? (b) carbohydrate? (c) salt? (d) fluid? (e) protein? (f) consistency? (g) size of feeding? (h) intervals of feeding?
3) Plan a diet for a patient with cardiac failure showing changes from the time of beginning till the patient is on a nearly normal full diet?
4) What changes may be necessary in a diet for hypertension? If artherosclerosis is also present?
5) Plan an anti-anaemia diet for a patient who has a long standing chronic haemorrhage.

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PART V

MICROBIOLOGY

Chapter 1

INTRODUCTION AND HISTORY

Microbiology is one of the sciences, which forms the foundation of professional nursing. The basic principles of several nursing procedures are drawn from the science of microbiology. A fresh nursing student may be slow to recognise the influence of microbiology on nursing but as she advances in her field she will be able to see the application of the science in many ways in her every day care of patients.

A knowledge of microbiology is of value to every person for the simple fact that even ordinary rules of cleanliness and hygiene are based on it. This knowledge is specially required by the nurse of today as she is an important member in the field of preventive medicine. With the advantage of a better scientific background she has an increasing responsibility to practice and teach hygienic measures both in the care and prevention of diseases.

In order to see how microbiology affects the practice of nursing and in order to get an insight into the study of the subject, few nursing situations are presented here. Each situation involves one or more microbiological principles.

1. The nurse washes her hands carefully after caring for one patient before she proceeds to care for another;
2. A clinical thermometer used for a patient is disinfected before being used for a second patient;
3. Instruments and dressings required for a surgical procedure are sterilised and kept sterile in suitable closed containers;
4. A patient admitted to the hospital with suspected typhoid fever is placed in an isolation unit. The nurse takes precautions to prevent spread of infection to other patients and to protect herself.

The study of microbiology aids the nurse in several ways. She learns how disease producing organisms enter the body and how they are discharged from the body and how they spread from person to person. She understands the principles of disinfection and the action of certain drugs on microorganisms. She recognises the importance of the proper collection of specimens of bacteriological examinations and is able to understand the meaning of reports received from the laboratory. In addition she learns how sera and vaccines used in the treatment and prevention of diseases are prepared and their effects on the human body.

Microbiology has been defined as the study of living organisms which are so small that they can be seen only with the aid of a microscope. Hence people did not have any definite idea of microorganisms till a few centuries ago but disease and death has always puzzled man's reasoning mind. Measures to protect people from communicable diseases were adopted by people in ancient countries like Egypt, India, China, Greece and Rome. These measures have been recorded in the writings of that period. Centuries before Christ (Leviticus chapter 13 and 14) patients with leprosy were segregated. During the middle ages the three devastating diseases which were pandemic and caused death were leprosy, plague and syphilis. Isolation hospitals and quarantine were introduced in some countries to try to control these diseases.

The modern ideas that infectious diseases are transmitted from person to person through actual contact between people, their clothing and other objects and also through air was first introduced by *Francastorins* of Verona (1546). He noted that the infection was the same for the person who received as for the person who had given the infection and that each disease was caused by a separate agent. His view was appreciated only after the discovery of microscope a century later by *Antony Van Leeuwenhoek*. In 1683 he made accurate descriptions of various types of bacteria. *Oliver Wendell Holmes* in USA (1843) and *Ignaz Semmelweis* in Vienna (1846) had concluded that puerperal sepsis was transmitted by the contaminated hands of obstetricians and medical students. They demonstrated that simple hand washing in antiseptic solution reduced the incidence of sepsis.

Louis Pasteur in 1857 established that fermentation was the result of the activity of certain microorganisms and that all forms of life including microbes arose only from their likes and not by spontaneous generation. In the course of these studies he introduced techniques of sterilization and developed the steam sterilizer, hot-air oven and autoclave. He also established the differing needs of different bacteria. He developed vaccine for immunization against anthrax. The greatest impact in medicine was made by Pasteur's development of a vaccine against rabies (hydrophobia). Louis Pasteur is considered as the *father of bacteriology*.

Joseph Lister introduced antiseptic spray during surgery and reduced mortality and morbidity after surgery (1867). He is considered to be the *father of antiseptic techniques in surgery*. *Robert Koch* (1843 – 1910) is considered to be the *father of perfected bacteriological* techniques of culturing and staining for the study of bacteria. He discovered the bacillus causing anthrax (1876), tuberculosis (1882) and cholera vibrio (1883). Other discoveries followed which include, leprosy bacillus by *Hansen* (1874) gonococcus by *Neisser* in 1879, staphylococcus by *Ogston* (1881), malarial parasite by *Ronald Ross* (1902), dipththeria by *Klebs* in 1883, and yellow fever in 1899 by *Walter Reed*. The existence of virus which passed through filters which held back bacteria was discovered in the twentieth century. The first human disease proved to have a viral aetiology was yellow fever. Walter Reed established in 1902 that yellow fever is caused by a virus and also that it is transmitted through the bite of infected mosquitoes. The visualization of even small viruses was made possible by the introduction of electron microscope by *Ruska* in 1934.

It had been noticed from ancient days that persons surviving an attack of smallpox did not develop the disease when exposed subsequently. This observation had been applied for the prevention of the disease by intentionally producing a mild form of smallpox . This practice was prevalent in India, China and other ancient countries. *Edward Jenner* in England introduced vaccination against smallpox using cowpox material in 1796. Jenner's vaccination paved the way for the ultimate eradication of smallpox in 1980. Louis Pasteur developed vaccines against cholera, anthrax and rabies. Gradually during the early part of twentieth century vaccines and sera for

prophylaxis and treatment of infectious diseases was developed.

The discovery of blood groups by *Karl Landsteiner* in 1900 was a vital contribution to safe surgery. Considerable advances have also been made in the field of immunology and immunodeficiency diseases, congenital-- iatrogenic as well as acquired.

Following the identification of specific microorganisms as the causative agents of diseases, efforts were made to develop agents to kill these organisms without damaging the body tissues. *Paul Ehrlich* in 1910 discovered salvarsen an arsenical yellow powder preparation against syphilis. It was called the 'magic bullet' and Ehrlich is called the *father of chemotherapy*. The discovery of pencillin by *Sir Alexander Fleming* in 1929 started the era of antibiotics. As new antibiotics and other drugs were discovered, the micro-organisms started fighting back and developed resistance to drugs. Sensitivity test has become a routine for rational therapy. Multidrug therapy also developed in order to prevent or delay the development of drug resistance.

With the development of a wide variety of antibiotics and effective vaccine against most vital diseases and global eradication of smallpox in 1980, it appeared that in future it would be possible to eliminate infectious diseases. But with the appearance of emerging and re-emerging disease producing microorganisma like Ebola virus (1977) producing haemorrhagic fever and Human Immuno deficiency virus (1981) producing AIDS, it appears that greater vigilence is necessary to protect man from microbes.

Studies on micro-organisms have contributed, more than anything else to the study of genetic code and other mysteries of biology at the molecular level.

CHAPTER 2

DISTRIBUTION OF MICROORGANISMS AND THEIR CLASSIFICATION

Microorganisms are widely distributed in nature. They are found on the skin, in the water and food we ingest and in the air we breathe. They are plentiful in the upper layers of the soil. Individuals like nurses who are involved in the care of the sick, are apt to think of microorganisms only in relation to their harmful effects to the human body. Of nearly two thousand species of microorganisms, which are known today, only a small number produce disease in man and are called pathogenic.

The majority of microorganisms are helpful. The organisms in the soil carry on useful activities such as decomposition of dead animal and vegetable matter. The organisms which live on decaying or dead organic matter and cause putrifaction are called saprophytes. Some organisms ferment food stuffs and are used in industries to manufacture alcohol, lactic acid, butter, cheese and other substances.

Living organisms are classified into plant, animal and protista kingdoms. Microorganisms belong to the protista kingdom. Based on differences in cellular organisation and biochemistry the kingdom protista has been divided into

1) Prokaryotes (Primitive nucleus): Prokaryotic cells have a simple structure and the nuclear material is free within the cytoplasm.

e.g. bacteria, blue green algae.

2) Eukaryotes (true nucleus): Eukaryotic cells have their DNA enclosed within a nuclear membrane, and a clear nucleus can be seen under the microscope eg: protozoa, fungi and algae.

Virusus are microorganisms without a cellular organisation. Therefore they are dependent on the host cells for replication. They are intracellular parasites.

According to the mode of living, microorganisms and their study may be classified as follows

1. Protozoa	Protozoology
2. Algae	Phycology
3. Fungi	Mycology
4. Bacteria	Bacteriology
5. Virusus	Virology

In some parts of the world including India large parasites, such as helminths are also a major cause of morbidity. Their presence in the body is diagonosed by the presence of microscopical ova in faeces and other specimens.

Size of Microorganisms

The unit of measurement used in bacteriology is the micron (micrometer)

1 micron (μ) or micrometre (μm) = one thousandth of a millimetre

1 millimicron (mμ)	==	OR	One thousandth of a micron
Nanometre (nm)	==		one millionth of a millimetre

The limit of resolution with the unaided eye is about 200 (microns). Bacteria of medical importance generally measure, 0.2 to 1.5μ in diameter and about 3-5μ in length. Therefore bacteria can be seen only under the microscope.

BACTERIA

Bacteria are minute organisms ranging in size from 0.3 to 14μ in length (1 μ) = 0.0001 mm. They differ from higher plants in that they do not contain chlorophyll and in that some are actively motile. Nearly 2 billion average size bacteria can be contained in a single drop of water. Of the various groups of microorganisms bacteria are the

ones which are easiest to study in order to learn the principles of the science.

PROTOZOA

They are the smallest celled animals and can range in size from 5 to 50 m, much larger than most bacteria. They possess a nucleus surronded by a limiting membrane lying within the cytoplasm which is divided into endoplasm (concerned with nutrition) and ectoplasm (which obtains the food). The ectoplasm may actively flow into pseudopodia to allow movement or the cell may have flagella or cilia. Most protozoa are saprophytes, living on dead organic matter while a few cause disease in animals and plants. Protozoa causing human diseases include Plasmodium causing Malaria, Glardia causing Giardiasis, Leishmania donovani causing Kala Azar, Trichomonas causing urogenital tract infection, Entamoeba hystolitica causing dysentery, and Criptosporidia causing diarrhoeal diseases.

FUNGI

These are microscopic plants without colouring matter. Fungi may reproduce sexually or by spore formation. These are divided into 4 groups.

1. Yeasts: rounded or oval cells which reproduce by budding. E.g., Cryptococcus neofomans.
2. Yeast like fungi: like yeasts, most will reproduce by budding but some form filaments eg: candida albicans.
3. Filamentous fungi: these grow as filaments (hyphae) which interweave into a mesh (the mycelium). They reproduce by asexual spores eg: Aspergillus, and ringworm fungi.
4. Dimorphic fungi: these grow in two forms according to their situation, as yeasts in the body but form mycelia in the environment or in culture eg: Blastomyces and Histoplasma. Fungi are much larger than bacteria in size which varies from 1.5 to 1000 m in diameter.

Some fungi (moulds) induce or cause disease in man and animals when foods or feeds containing them are consumed. The toxic

compounds produced by fungal contamination of food are termed mycotoxins and the resulting diseases are called mycotoxicosis.

Fungal diseases (mycoses) are of two types 1) superficial; (those affecting the skin only), 2) deep seated (systematic). The latter are usually pathogenic only as 'opportunists' taking advantage of lowered host resistance. Superficial mycoses include candidiasis and moniliasis caused by candida albicans and ringworm of dermatophytes.

Deep mycoses include Maduramycosis or Madura foot (reported by *Gill* from Madurai, South India in 1842) and Histoplasmosis caused by Histoplasma copsulatum.

VIRUSES

Viruses are the smallest living units. They pass through filters that hold back bacteria and cannot be seen with ordinary microscope. Therefore they were called filterable and ultramicroscopic. They can be seen only through electron microscope. Viral diseases range from minor ailments such as common cold to highly fatal diseases such as rabies, yellow fever, hepatitis B and AIDS (Acquired Immuno Deficiency Syndrome). They may be sporadic such as mumps, endemic such as rabies, epidemic such as measles or pandemic such as influenza.

There are three important ways in which viruses differ from other micro-organisms.

1. Viruses vary in size from 20 to 200 mm whereas staphylococci measure 1000 nm. Therefore they can be studied only with an electron microscope.

2. Viruses contain only one type of nucleic acid, either single or double stranded DNA or RNA and never both.

3. Viruses cannot grow on lifeless media such as agar, but only within living susceptible cells.

Viruses have no independent metabolic activity. They replicate only within a cell of a living plant or animal host. The virus provides the genetic code for replication and the host cell provides the necessary energy and raw material.

Three methods are employed for cultivation of viruses: inoculation into animals, embryonated eggs and tissue cultures.

Viruses are inactivated by sunlight, ultraviolet rays, ionising radiations and chlorination, but are more resistant than bacteria to chemical disinfection. They are readily inactivated by heat. Antibiotics which are active against bacteria are completely ineffective against virus.

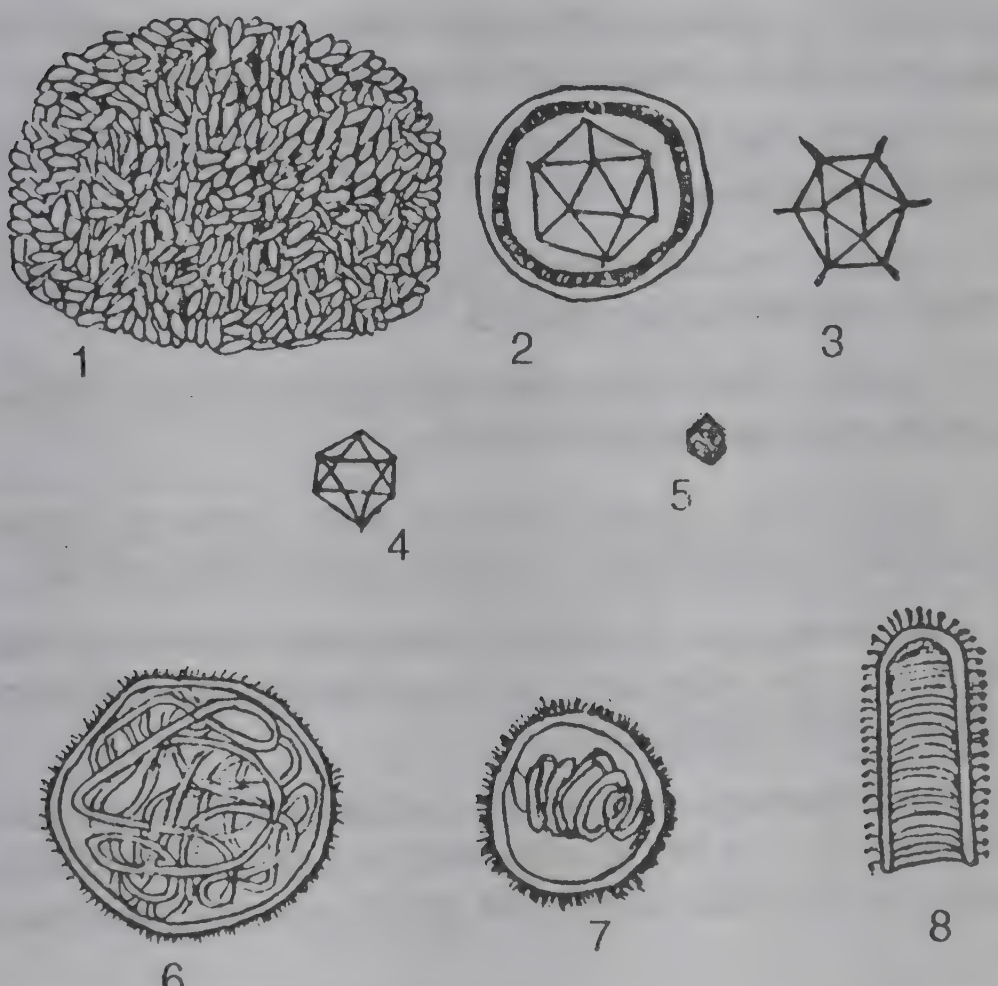


Figure 1

Shape and size of viruses

1. Poxviridae 2. Herpetoviridae 3. Adenoviridae

4. Papovaviridae 5. Picornaviridae

6. Paramyxoviridae 7. Orthomyxoviridae 8. Rhabdoviridae

CHAPTER 3

CHARACTERISTICS OF BACTERIA

Depending on the shape and arrangement, bacteria are classified into:

a) Cocci - spherical bacteria and may appear in chains (strepococci), clumps (staphylococci) or pairs (diplococci).

b) Bacilli - rod shaped bacteria. They may vary from chains to club shaped organisms.

c) Vibrios - comma shaped, curved rods with vibratory mobility. E.g. Vibrio cholerae causing cholera.

d) Spirilla - rigid spiral forms eg: Spirillum minus causing one type of rat bite fever known as Sodoku.

e) Spirochetes - longer flexuous spiral forms eg: Treponema pallidum causing syphilis and leptospira causing leptospirosis.

f) Actinomycetes - branching filamentous bacteria, resembling radiating sun rays when seen in tissue lesions eg: Actinomycosis, Nocardiosis and Maduramycosis.

g) Mycoplasmas - tiny bacteria smaller than large viruses which lack cell walls, but can live independently and grow on artificial media. Diseases caused in humans include a typical pneumonia and puerperal fever.

h) Chlamydiae - intracellular parasites which are filterable and fail to grow in cell free media but they possess both DNA and RNA and are susceptible to the usual antibiotics. Human diseases caused by chlamydiae include Trachoma and Lymphogranuloma venereum.

i) Rickettsiae - small gram negative bacilli. They are unable to grow in cell free media but possess both DNA and RNA. They are susceptible to tetracycline and chloramphenicol. Diseases caused include typhus fever, spotted fever, trench fever and Q fever.

BACTERIAL CELL

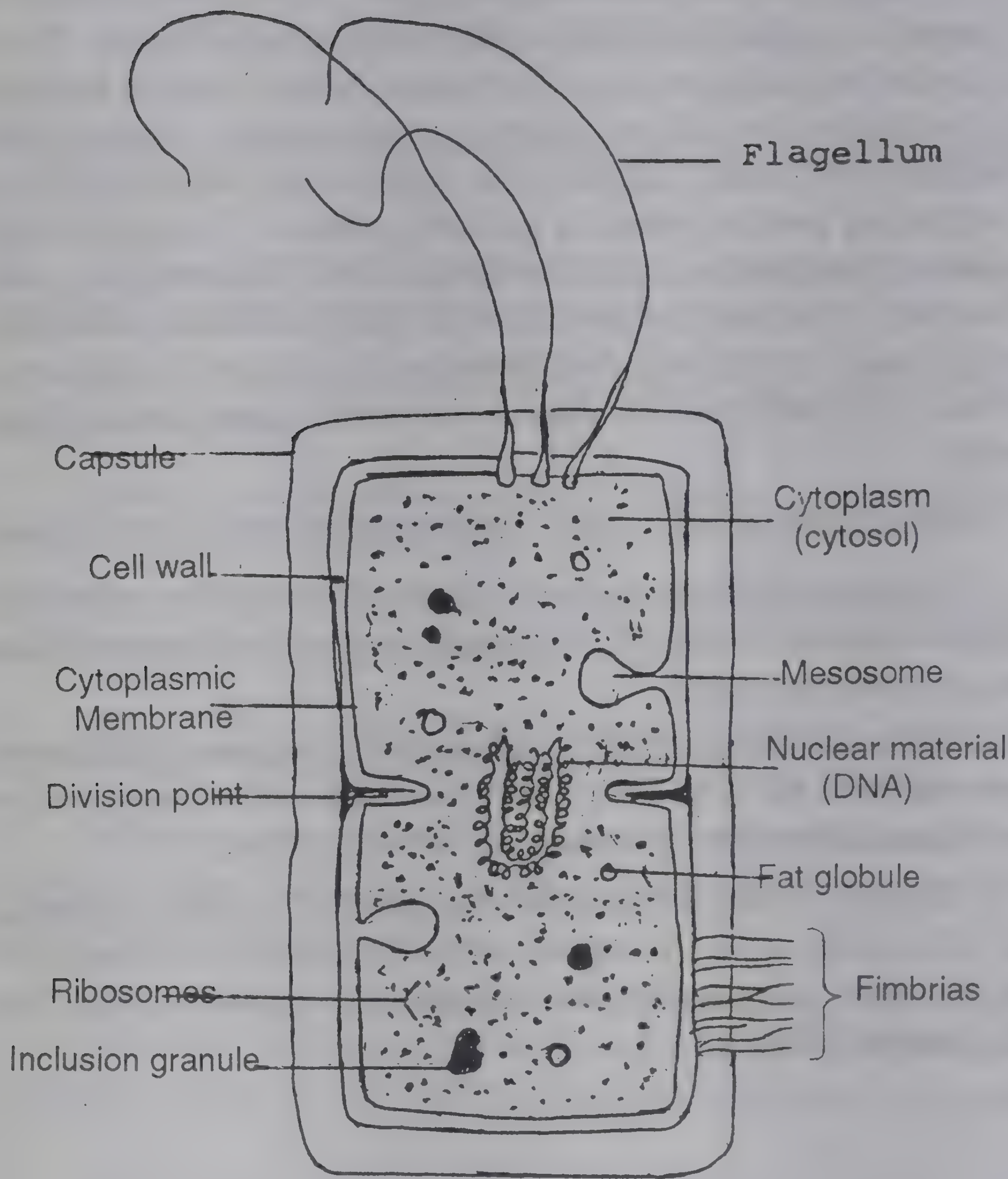
Bacterial cells are prokaryotic cells. These cell contents are enclosed by a rigid cell wall which preserves the shape of the organism. The cell contents inside the membrane are liquid. It has a nuclear material or deoxyribonucleic acid (DNA) coiled and loosely arranged. This is surrounded by cytoplasm which contains the mechanisms necessary for maintaining the cell and allowing reproduction. These include ribosomes (RNA) which manufacture protein, mesosomes which act as respiratory centres, granules and fat globules. The rigid cell wall encloses a thin flexible cytoplasmic membrane. The membrane allows diffusion to take place between the cell cytoplasm and environment Mycoplasmas, rickettsiae and chlamydiae do not have the rigid outer cell wall. The bacterial chromosome replicates (reproduce by binary fission).

Some bacterial cell wall may be having one or more of the following.

1. Flagella which are filaments protruding from the cell surface and are organs of locomotion, common to most gram negative and few gram positive bacilli.

2. Fimbriae (Pili) are short, stout hair like processes which are not concerned with motility. They function as organs of adhesion, helping the cells to adhere firmly to particles of various kinds.

3. Capsule – Many bacteria secrete a protective layer around the cell surface known as the capsule which protects the bacteria from harmful agents and phagocytosis. A diagramatic appearance of bacterial cell is shown in Fig. 2.



The anatomy of a bacterium (prokaryotic cell)

REPRODUCTION

Most bacteria multiply by simple fission or by dividing into halves, a process known as binary fission. Reproduction takes place at an extraordinary rate in a favourable environment. If one cell divides at the rate of once an hour the descendants of the cell would number nearly 20 million (20,000,000) at the end of a day. Some bacteria may divide as frequently as once in twenty minutes. The generation time for tubercle bacilli is 20 hours and for lepra bacilli 20 days.

MOTILITY

Many bacilliae and spirillae are able to swim and move around when suspended in suitable liquid. This movemet is due to fine hair-like appendages known as flagellae. Examples of organism which have motility are typhoid bacilli and cholera vibrio.

SPORE FORMATION

When conditions are unfavourable for bacterial growth, some of the rod shaped organisms have the power of forming spores. A spore is formed within the body of the bacterium by the collection of protoplasm into a compact mass usually round or oval in shape. Around this an extremely resistant covering is formed. These spores may be blown about and can resist drying, sunlight, heat, disinfectant and other unfavourable conditions for a long period. When conditions become suitable again for bacterial growth, the spores germinate into bacteria and multiply. This is called the vegetative form. The important pathogenic spore forming bacteria are those that cause tetanus, gas gangrene and anthrax. To destroy the spores, contaminated articles have to be placed under high temperatures of steam under pressure.

CAPSULE FORMATION

Surrounding many bacteria there is gelatinous envelope called a capsule. This may be a very thin film, sometimes white. In others it is a thick covering making the organism resistant to protective mechanisms of the body. The pneumococcus is an example of an organism capable of producing a capsule.

FACTORS AFFECTING THE GROWTH OF BACTERIA

1. Moisture

Like all living things, bacteria are sensitive to their environment. Water is necessary for the growth of bacteria because they cannot absorb food material unless it is in solution. The fact that bacteria cannot grow in the absence of water is demonstrated in preservation of food by drying e.g., fish, meat and fruits.

2. Food and metabolism

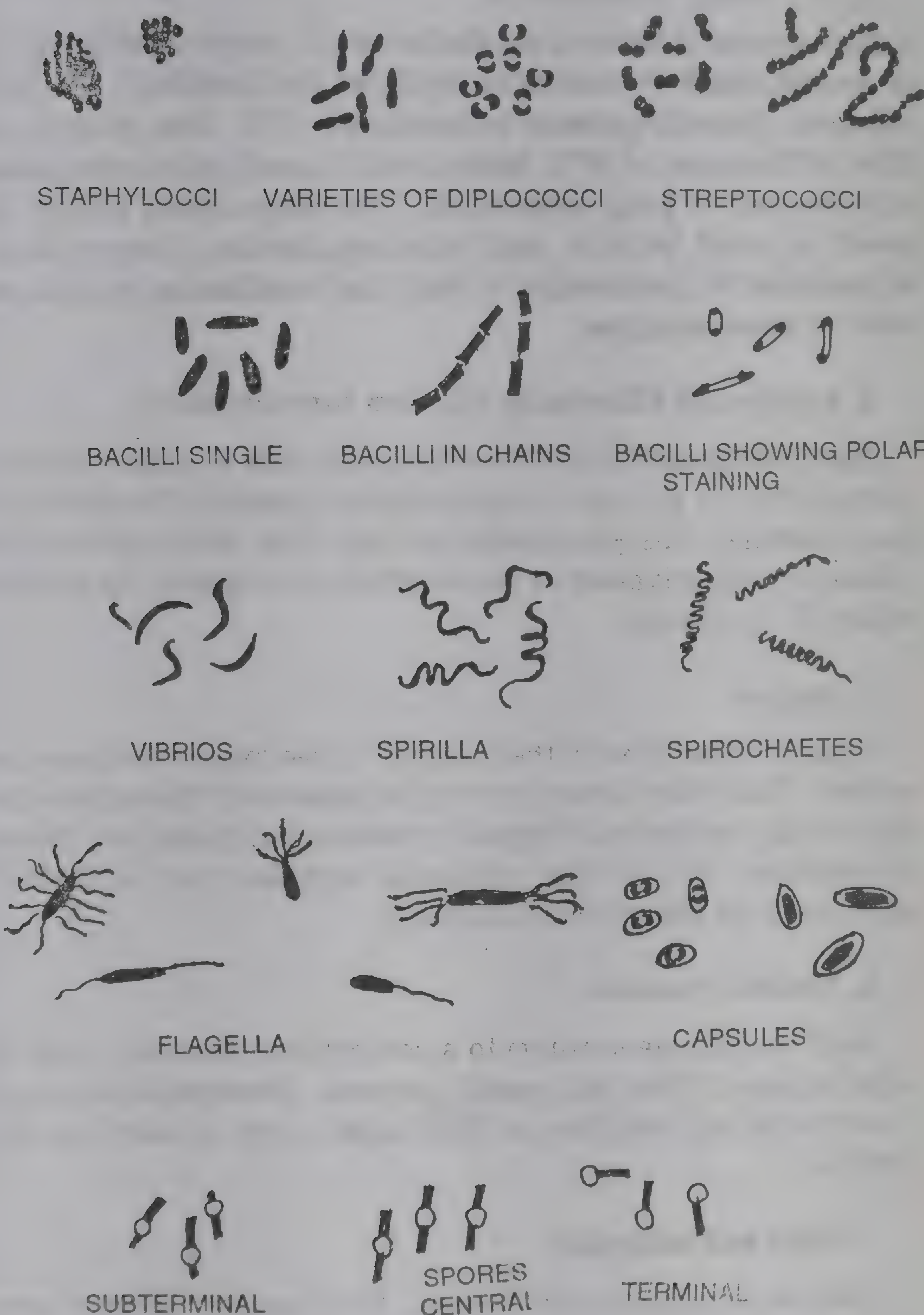
Bacteria obtain their nourishment from organic and inorganic matter for growth and multiplication. The minimum nutritional requirements are a source of water, carbon, nitrogen and some inorganic salts. Some bacteria require vitamins.

Many of the organisms oxidize glucose just as higher animals do and some are able to build up protoplasm through complex processes. Some require vitamins such as nicotinic acid, thiamine and riboflavin and use them in the same manner as human beings do.

Organisms which live upon or within other living organisms like human beings, animals or plants are called parasites. The majority of these are harmless to man (non-pathogens).

Some organisms are able to live in the outside world on dead material and are known as saprophytes. The main activities of saprophytic organisms are putrefaction and fermentation. Putrefaction means the breaking down of protein and is very useful in the decomposition of dead animal and vegetable matter. By this process the complex substances contained in refuse are converted into simple elements which can be utilized by plants as foods.

Fermentation refers to changes which microorganisms bring about in carbohydrates. A familiar example is the production of alcohol from the sugar of fruit juices. Therefore we find that certain kinds of microorganisms are used in industries to manufacture alcohol, lactic acid, butter and cheese.



DIFFERENT TYPES OF BACTERIA

3. Optimum temperature

Each species of bacteria requires a certain temperature range for its growth which is termed as optimum temperature. For most pathogenic bacteria optimum temperature is 37°C. Most bacteria are killed in 30 minutes at 56°C. Bacteria which usually attack the human body live best at body temperature. Low temperatures inhibit the growth of most bacteria and high temperatures destroy them. Refrigeration for preservation of foods and sterilization by heat are based on these principles.

4. Acidity and Alkanlinity (H – ion concentration)

Most pathogenic bacteria grow best in a neutral or slightly alkaline medium (PH 7.2 to 7.6). An acid medium prevents the growth of many bacteria. The preservation of fish, meat and vegetables by pickling in vinegar is based on the sensitivity of bacteria to the extreme acidity of the vinegar.

5. Oxygen

Organisms that grow in the presence of free oxygen are known as aerobes. Those that cannot grow in the presence of free oxygen but obtain their oxygen from oxygen containing compounds are known as anaerobes. A few of the pathogenic organisms such as those of tetanus and gas gangrene are anaerobic.

6. Osmotic Pressure

Many bacteria are sensitive to a concentrated solution of salt or sugar because of their high osmotic pressure. Preservation of food in concentrated salt solution or thick sugar syrup is based on this principle.

7. Light and radiation

Most bacteria grow well in the dark. Direct sunlight destroys many bacteria within a few minutes or hours. It is therefore possible to disinfect articles by exposing them to sunlight. Mattresses, pillows and blankets used in a hospital ward are often disinfected by this

method. Ultraviolet rays and radiation also destroy bacteria. Special lamps which produce ultraviolet rays also destroy bacteria. Such lamps are sometimes used in the treatment of skin infections.

CHAPTER 4

METHODS USED FOR THE STUDY OF BACTERIA

The bacteriologist uses a number of procedures to identify an unknown bacterium. In their natural state bacteria appear under the microscope as tiny colourless spheres or rods which are difficult to see especially if they are not of an actively motile variety. In order to see them distinctly, they are usually stained with different types of dyes. Simple or differential stains may be used.

1. Microscope

Certain specialized instruments are required to visualize and study bacteria. The microscope is the most necessary device. Microscope has come a long way since Leeuwenhoek first observed bacteria using his microscope three hundred years ago. A general description of microscope is given in Fig.4. Bacteria may be examined either in the living state or after staining, using an optical or light microscope. Other microscope include Dark field microscope and Electron microscope. With an ordinary microscope the magnification is about 100 to 900 times.

Direct Microscopical Examination

Hanging drop method (Fish in stream appearance)

Living bacteria may be examined without staining them. A drop of fluid containing the bacteria is placed on a bit of very thin glass which is then inverted over a cavity in a special slide. Actively motile organisms are seen darting, rolling and bumping into one another. The power of movement is due to the presence of flagella. Example of motile organisms are the typhoid bacillus and cholera vibrio.

Dark field illumination method

This is a method in which the dark field microscope is used to look at the living bacteria, particularly, those which are so thin that they are not visible through the ordinary compound microscope. In the dark field microscope reflected light is used instead of transmitted light. The light rays touching the specimen will be reflected directly with the object with the result that the specimen looks white against a dark background. Many pathogenic spirochetes are examined this way.

Electron microscope

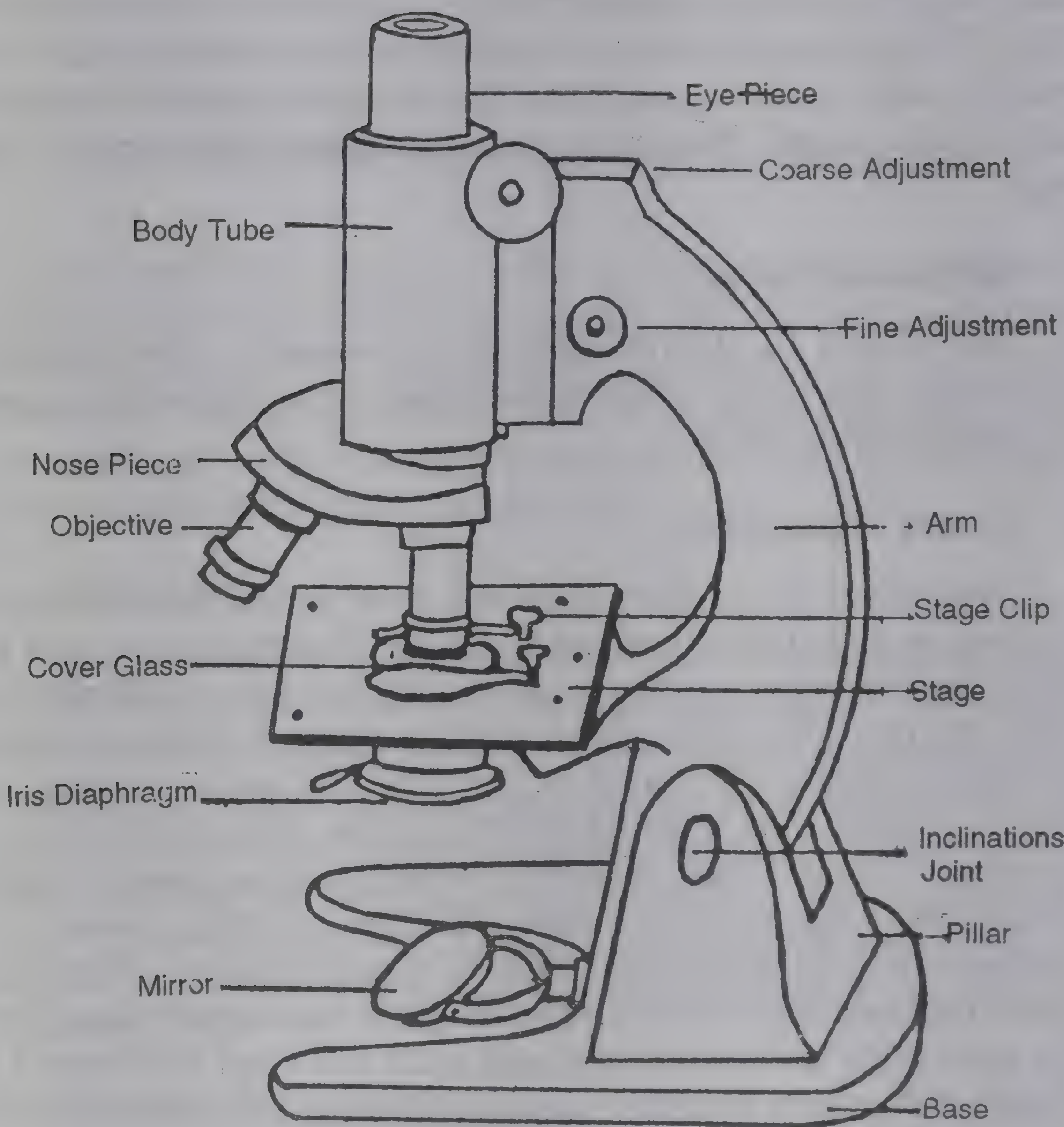
This is used to identify viruses in specimens. The electron microscope uses a beam of electrons instead of the beam of light used in the optical microscope.

Stained Preparations

Live bacteria do not show much structural details under the light microscope due to lack of contrast. Hence different dyes are used to stain them to produce colour contrast. Bacteria have an affinity for basic dyes due to the acidic nature of their protoplasm. Before applying the stain, a smear is prepared on the slide. To prepare a smear for staining a clean slide is spread with a thin film of the material to be examined. After the smear is dried in the air the slide is passed through a flame three or four times. Flaming kills the bacteria in a smear and makes them stick to the slide. This is known as fixing. When the smear has been fixed, it is covered with a stain such as methylene blue for one minute and then washed with water and dried. This type of a simple stain shows well the size and shape of the organisms, but there are other methods which give more information about the organisms.

Differential staining

(a) Gram stain: The gram stain was originally devised by a Danish histologist, *Christian Gram* in 1884 AD. Gram's method of staining divides bacteria into two great groups: those that are Gram-positive and those that are Gram-negative.



THE MICROSCOPE

The procedure is as follows:

Prepare smear

(i) Cover the smear with methyl violet solution. Leave it for one minute. Wash with water.

(ii) Cover with Gram's iodine. Leave for 1 minute. Wash with water.

(iii) Decolourise by covering with alcohol for a few seconds. Wash with water.

(iv) Cover with safranine for 30 seconds. Wash with water and dry.

Gram-positive bacteria retain the crystal violet in spite of the alcohol treatment and appear dark purple under the microscope. Gram-negative bacteria are completely decolorised by the alcohol and the second stain is used in order to make them visible. These bacteria appear pink in colour when safranine is used as the counter stain.

Examples:

Gram-positive organisms	*Gram-negative organisms*
Pneumococcus	gonococcus
Streptococcus	meningococcus
Staphylococcus	typhoid bacillus
Tetanus bacillus	Dysentery bacillus

(b) Acid fast stain by Ziehl – Neelsen technique

Prepare smear as above, flood it with carbol fuchsin (a red dye). Gently steam over a flame for three to five minutes, do not boil. Wash off the excess of stain with a gentle stream of water. All bacteria will now be red. Decolorise by covering the slide with 20% sulphuric acid for one minute. Wash with water. Apply methylene blue for one minute and then wash. The acid fast organisms will appear red and the others blue. Examples are Mycobacterium tuberculi and Mycobacterium leprae.

(c) Negative staining

Here the bacteria are mixed with dyes such as Indian ink that provide a uniformly coloured background against which the unstained bacteria stand out in contrast. Very slender bacteria such as spirochetes that are not demonstrated by simple staining methods can be visualised by negative staining.

There are also special stains available for identifying various spores, mycobacteria, etc.

Serological Reactions

Serological tests are based on antigen-antibody reactions. Antigens and antibodies combine with each other specifically and in an observable manner. Antigen-antibody reaction help us to detect the presence and the identification of antigens and antibodies. The presence of antibodies in the serum shows that the body has reacted against the particular antigen or related antigen. Hence testing for an antibody is a method for diagnosis of infection produced by the organism containing the antigen.

Measurement of antigen and antibody is usually in terms of units or titre. The antibody titre of a serum is the highest dilution of the serum which gives an observable reaction with the antigen in a particular test. Similarly the value of an antigen can be detected against known serum. A few of the antigen-antibody reactions are:

1. *Precipitation reaction*: In this type of reaction when the soluble antigen combines with its antibody in the presence of electrolytes (Nacl) at a suitable temperature and PH the antigen-antibody complex forms an insoluble precipitate. This precipitate may form a sediment. Eg. Venereal Disease Research Laboratory (VDRL) test for syphillis, Hepatitis B antigen and Cryptococcal antigen in cerebrospinal fluid.

2. *Agglutination*. In certain antigen antibody reactions the particles are clumped or agglutinated. Eg. Blood grouping and cross matching, Widal test used in typhoid, Weil Felix reaction in typhus, detection of hepatitis B and antistreptolysin O (ASO) in Rheumatic fever.

3. *Enzyme linked immunosorbent assay* (ELISA) and *Western Blot*

(WB) *assays*. ELISA test is the most widely employed technique for detection of antigens, antibodies, hormones, toxins and viruses. The western blot (immunoblot) is the most confirmatory technique for a positive HIV antibody immunoassay.

4. *Radioimmunoassays* (RIA). It is an extremely sensitive technique in which antigen or antibody is labelled with a radioactive material. Since RIA involves handling of radioactive material, it is available only in a few selected reference laboratories.

5. *Polymerase chain reaction* (PCR). This is a method based on amplification of their constituent nucleic acids either in DNA or those in RNA. The test is simple and accurate but expensive. This amplification based assays are available to diagnose different infections.

CULTIVATION OF BACTERIA IN CULTURE MEDIA

It is often impossible to identify bacteria by microscopic methods alone, because of their similarity in appearance and staining reactions. So further study of bacteria is made by observing their growth on artificial food materials prepared in the laboratory.

A sterile mixture of nutrients which will encourage bacterial growth is called as culture medium and the growth itself is known as culture. The culture medium must contain the necessary nutritive substances and must be of the proper acidity or alkalinity. The different kinds of culture media used frequently are nutrient broth, which is a liquid containing meat juices and made by cooking meat in water, (nutrients such as peptones may be added to it); broth containing carbohydrates, such as dextrose; nutrient agar, which is a solid medium; and blood agar which has blood added for a nutrient. Most of the bacteria have some medium on which they grow best, and a few will grow only on media specially prepared for them. At times substances are added to media which are favourable to some organisms and unfavourable to others so that study of the former is made easier.

A culture is made by removing some of the material to be examined such as sputum, urine or pus, with a platinum loop and dipping it into a fluid medium or rubbing it gently over a solid medium. It is

then kept at the required temperature for which an incubator may be used. The bacteria multiply very quickly in the medium and within eighteen to twenty-four hours masses of bacteria are usually visible to the naked eye on the surface of the solid medium, and the liquid medium is visibly cloudy. The masses, each of which is composed of millions of bacteria of the same kind, are called colonies. Each colony originates from one single bacteria cell. The colonies of different bacteria vary in appearance, size, shape and colour and these characteristics are valuable in differentiating one kind of organism from the other.

CHEMICAL CHANGES

Another method of study is to find out the chemical changes which the organisms, by means of their enzymes, can bring about in various substances. Some can cause formation of acid when grown in different sugars and others produce acids and gases. E.g., Escherichia coli ferments lactose, with production of acid and gas.

ANIMAL INOCULATION

In studying pathogenic bacteria, sometimes it is necessary to inject them into animals. Animals react to many kinds of bacteria in much the same way as men do and the organisms often cause the same kinds of changes in their bodies. The animals most often used for this purpose are guinea pigs, mice and rabbits.

For instance, non-pathogenic organisms related to tubercle bacilli which grow slowly on culture media, may have culture characteristics very similar to those of tubercle bacilli. Inoculation of these into guinea pigs will show whether the organisms are pathogenic or not. Guinea pigs may also be inocuolated directly with suspected material like sputum or urine. In either case autopsies will reveal if the culture was one of the true tubercle bacilli or if the specimen directly inoculated contained tubercle bacilli.

PROPER COLLECTION OF SPECIMENS

The collection of material for bacteriological examination is often the responsibility of the nurse and proper collection is just as important as any other part of the bacteriological investigation. The specimen should be collected in such a manner that it does not become contaminated with other organisms.

Important points to be remembered are:

1. Use strict aseptic precautions.
2. Use always sterile containers.
3. Avoid soaking the outside of the containers.
4. Proper transport; if delay is expected, refrigerate the specimen.

After microscopy, the microbiologist proceeds immediately to culture the specimen for pathogenic bacteria on appropriate media. The cultures are grown in an incubator, the temperature of which is the same as human body temperature namely, 37 C.

Till culture work, most specimens must be kept in a refrigerator, though some bacteria may not survive, if kept in the refrigerator.

METHODS OF COLLECTION OF SPECIMENS FOR CULTURE

The following are the methods undertaken for collecting specimen for culture studies:

Blood: Blood should be drawn under strict aseptic conditions. Prepare the skin as for a minor surgical procedure. Wash and dry before attempting to draw the blood sample. Wear gloves to prevent the risk of acquiring hepatitis B or AIDS infection.

After withdrawing the blood, the needle should not come in contact with anything. The blood should be immediately inoculated into the culture media. Any fault in technique will lead to contamination of the blood/specimen.

At least 10 ml of blood is taken from the patient when he is having fever. Taking special precautions, i.e. after lifting the adhesive over

the cap of the blood culture bottle 5ml of blood is to be inoculated through the hole in the lid into a bottle of culture medium and another 5 ml into the second culture bottle. The adhesives are refixed carefully. If anaerobic infection is suspected in the patient, additional media are to be used. After proper collection the culture bottles are incubated at 37°C and are never to be refrigerated.

Urine: Midstream or 'clean-catch' specimen is to be obtained. The specimen must be collected in a sterile wide-mouthed, screw-capped bottle after thorough preliminary cleansing of the genitalia with soap and water. Improperly collected urine specimen will lead to incorrect test report. The specimen must reach the laboratory within 15 minutes of collection if not it should be refrigerated immediately.

If infection with tubercle bacilli is suspected, the entire early morning sample of urine should be sent ina large special sterile bottle.

Faeces: A small quantity of formed stool is placed in a sterile specimen container. About 1/3rd of the container should be filled with stool. The container should never be filled completely. Special care should be taken to see that the outside of the container is not contaminated. If mucus or flakes of tissue is present in the faeces these should be included in the collected specimen. In certain cases like suspected bacillary dysentery or E. Coli diarrhoea, rectal swabs are preferred. Sterile swabs moistened in sterile saline are to be introduced well beyond the internal sphincter, twirlled well, gently withdrawn and placed in a sterile test tube and sent to the laboratory immediately.

Pus, other than purulent body fluids: About 1 ml of pus is placed in sterile test tube. If this is not possible, as much pus as possible is taken on 2 sterile swabs and replaced in a sterile test-tube. The ends of the swab sticks are never to be broken off. The tips of swab sticks should project beyond the mouth of the tube to facilitate handling. The mouth of the test tube with the projected tips of swab sticks must be secured with sterile cotton or gauge fastened with adhesive tape soon after collection.

Ear, Nose, Eye swab, Throat swab: Two swab sticks in a sterile test tube are used for collection of pus.

The throat swabs are taken as follows:

The patient's tongue is depressed and the 2 swabs passed well over the tonsils and surrounding areas and over the area where there is inflammation. The swabs with the specimen are to be placed in the sterile test tube. Care should be taken not to touch the inside of the cheek or tongue.

Sputum: As far as possible an early morning coughed up specimen is preferred. Instruct the patient to wash the mouth with plain water few minutes before taking the specimen. Few ml of coughed up specimen is placed in a sterile wide mouthed screw-capped bottle and despatched as early as possible.

Other Body Fluids: e.g., Pleural, Peritoneal, Pericardial, synovial, etc. These should be sent in sterile containers.

Blood for serological tests

For this investigation 10 ml of blood should be taken with a dry syringe and placed in sterile test tube or bottle. The bottle should not contain any anticoagulant. The blood should be allowed to clot. The blood should be placed in a container directly from the syringe after removing the needle to avoid haemolysis due to frothing (Forcing blood through needle can cause hemolysis).

CHAPTER 5

CONTROL OF BACTERIA

Although most micro organisms in the outside world are harmless, it is necessary to realise that some pathogenic species are often mixed with non-pathogenic ones and special precautions have to be taken to destroy them in order to prevent the spread of infectoins. It is essential for the nurse to understand the fundamental principles about the removal of micro organisms and have a good working knowledge of this procedure. In the discussion of the conditions affecting the growth of bacteria it was pointed out that bacteria are sensitive to drying, sunlight, extremes of temperature and other physical and chemical conditions. This information is useful in understanding how bacteria can be destroyed or removed. Before discussing in detail the various methods of destroying micro organisms, it will be helpful to define some of the terms used for removal of bacteria.

Cleaning – The removal of contamination such as dirt.

Disinfection – The destruction of all pathogenic organisms, not usually including bacterial spores.

Disinfectant – the substance which kills pathogenic organisms.

Antisepsis – the prevention of infection usually by inhibiting the growth of bacteria.

Antiseptic – the agent capable of producing antisepsis.

Bacteriocidal agents – substances which are able to kill bacteria

Bacteriostatic agents – substances which prevent the multiplication of bacteria and they may remain alive.

A chemical substance which is bacteriocidal at a specific concentration will be only bacteriostatic at a lower concentration (when further diluted).

Sepsis or infection implies the presence of pathogenic organisms.

Asepsis – the absence of infection or of pathogenic organisms. Disinfection and sterilization may be accomplished by mechanical, physical or chemical means.

MECHANICAL METHODS OF CONTROL

1. Scrubbing 2. Filtration 3. Sedimentation

Scrubbing is usually done with soap and water. The process itself removes many organisms, mechanically, and the soap in addition acts chemically. The nurse scrubs her hands every time she comes in contact with a contaminated article or infective material. The diagram in Fig. 5 illustrates the decrease in the number of colonies in a culture made after scrubbing the hands with soap water.

Bacterial filtration is the process of passing a liquid through a material filter, the pores of which are so small that the bacteria cannot pass through. Cotton plugs of culture tubes, gauze face masks and the special type of clay used for water filters are examples. This process is used in the laboratory and the pharmacy for sterilizing fluids that cannot be heated. The various types of filters in use are earthenware candles in Berkfield, Chamberland and Mandler filters.

Sedimentation is the process by which particles which hang suspended in a liquid settle to the bottom of a liquid carrying with them bacteria which stick to them. For purification of a large amount of water this method may be used along with other methods such as chlorination.

PHYSICAL METHODS

1.Moist heat	Boiling Steam under pressure Pasteurization

The nurse handling a contaminated bed pan

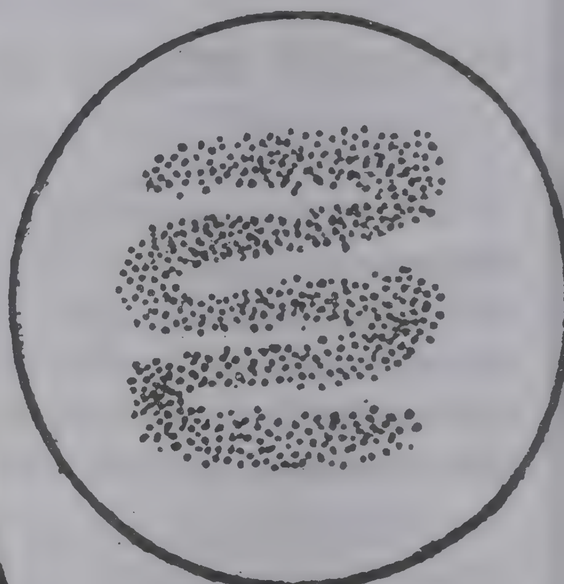
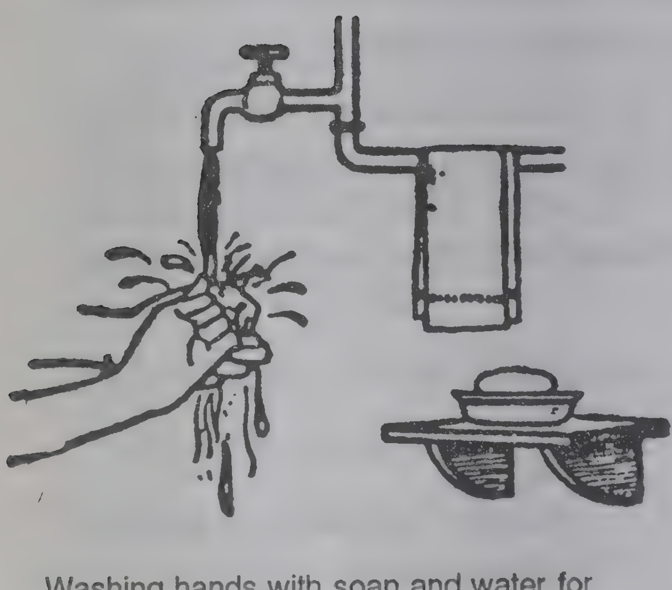


Plate showing growth of organism, in a culture made from the nurse's fingers



Washing hands with soap and water for three minutes

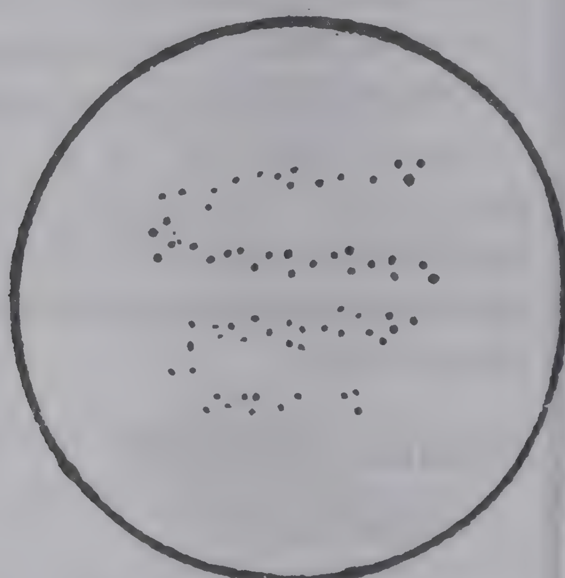


Plate showing a decrease in the number of colonies after washing hands

EFFECTIVENESS OF MECHANICAL REMOVAL OF MICROORGANISMS

2. Dry heat — Hot air, Incineration, Flaming
3. Sunlight
4. Drying
5. Radiation

1. Moist heat

(a) *Boiling*: Most of the pathogenic organisms are killed within 3-5 minutes by boiling. But spore forming organisms may not be killed for several hours. Boiling as a method of sterilization is not in practice. Ideally all surgical instruments must be sterilized by autoclaving.

(b) *Steam under pressure*: The apparatus used for sterlizing articles by means of steam under pressure is known as an autoclave. An autoclave contains an outer chamber and an inner chamber. The articles to be sterilized are packed in the inner chamber and the door is closed and screwed tightly. Steam formed by boiling water in the outer chamber passes into the inner chamber from which it is not allowed to escape. When steam is held in a closed container, it is compressed and the temperature rises far above that of the boiling point of water. The steam forces its way through all the materials to be sterilized. The articles are usually exposed to a pressure of 1.05 kg/cm2 (15 pounds/inch) of steam for fifteen to twenty minutes. The temperature of the steam at this pressure is about 121°C. Autoclaving may be used for objects which are not damaged by moisture or high temperature, e.g., dressings, gloves, linen, syringes and certain instruments as well as most culture media. In preparing the articles for autoclaving the nurse should see that the bundles are not too large and not packed too tightly as this will interfere with circulation of the steam and prevent its penetration into the centrally placed bundles.

In operating the autoclave, it is important to remember that all the air in the chamber must be driven out and entirely replaced by

steam. Otherwise, although the gauge may show a pressure of 1.05 kg/cm, the pressure would be caused by a mixture of steam and air and the temperature would be lower than that of steam alone. Thus the sterilizing ability of the autoclave would be lessened. The articles should be left in the autoclave for a short time after the procedure is over in order to dry the materials. Autoclaving is the most effective method of sterilization and is widely used in laboratories and hospitals.

* For determining the efficacy of moist-heat sterilization, spores of bacillus sterothermophilus are used as the test organism. This is a thermophilic organism with an optimum growth temperature of 55-60°C and its spores require an exposure of 12 minutes at 121°C to be killed. Paper strips impregnated with 10 spores are dried at room temperature and placed in paper envelops. These envelopes are inserted in different parts of a load and after sterilizing, the strips are inoculated into a suitable recovering medium and incubated for sterility test at 55°C for five days. Chemical indicators, autoclave tapes and thermocouples are also used instead.

(c) *Pasteurization*: This is a process of making milk or other foods safe by destroying all ther harmful organisms. It is a method of disinfection and not sterilization. It is named after *Pasteur* who discovered that wine could be prevented from spoiling by heating it to about 63°C. Now it is applied mostly to milk and very rarely to other foods. Milk is heated to a temperature of 60° – 65°C for half an hour and then cooled rapidly and kept cool. The heating destroys all the pathogenic organisms and reduces acid producing organisms, thus preventing the souring of milk for sometime. Pasteurization does not change the taste and composition of milk or destroy vitamins and is therefore preferable to boiling. In the flash method of pasteurization, the milk is heated to 72°C for 15 seconds and suddenly cooled.

2. Dry Heat

There are many articles such as glass-ware for the laboratory, syringes and needles, scalpels, etc., which can better be sterilized by dry heat. Bacterial protoplasm coagulates more readily when in contact with moist heat than with dry, so the temperature must be much higher comparatively when dry heat is used, as indicated below, and

*Ananthanarayan R, Jayaram Panicker CK Textbook of Microbiology,

must be maintained longer.

(a) *Hot air Oven*: A special oven which is similar to a home baking oven may be used for this method of sterilization. Articles are exposed to a temperature of 170 C for two or two and a half hours. The temperature is slowly raised and held for the required period after which the oven is allowed to cool slowly. This prevents breakage of glass-ware. Test tubes, Petri dishes, flasks and other glass-ware are sterilized by this method. Other materials which are not penetrated by moist heat such as Vaseline gauze or petroleum liquid paraffin, powder, etc. are also sterilized by hot air oven.

(b) *Incineration*: Articles which are very badly contaminated and materials such as sputum cups, infected dressings and garbage may be burnt in a furnace or in incinerator. This is known as inceneration and is an economical and effective method for disposable materials. There must be complete burning.

(c) *Flaming*: This is another form of burning by which an article is passed through an open flame. For example, the bacteriologist heats his platinum loop red hot in a flame to make it sterile, and the physician may in an emergency, sterilize an instrument by dipping it into methylated spirit and setting it aflame. Flaming may also be used for sterilizing small, smooth surfaced clean articles, sch as enamelware. In this case a small amount of alcohol or spirit is poured into the container and is set on fire. This is not however a satisfactory method for large basins and jugs and therefore should be used only in an emergency.

3. Sunlight

A large number of organisms may be killed in a few hours by exposure to bright sunlight owing to its ultra-violet rays. Blankets, pillows and mattresses may be disinfected by this method, specially in this country where the sunlight is available most of the year. It must be remembered however, that the rays do not penetrate and therefore only the organisms on the surface of the articles are affected. It is necessary to turn these articles to make certain all organisms on both surfaces are killed.

4. Drying

Moisture is essential for the growth of Bacteria. Drying has a harmful effect on it. Spores are unaffected by drying. This method is unreliable for disinfection or sterilization.

5. Radiation

Two types of radiation are used for sterilization purposes – ionising and non-ionising. Infrared and ultraviolet rays are non-ionising types and gamma rays and high energy electrons are of the ionising type. Infrared and gamma radiation and high energy electrons are useful for effective mass sterilization and so are used commercially.

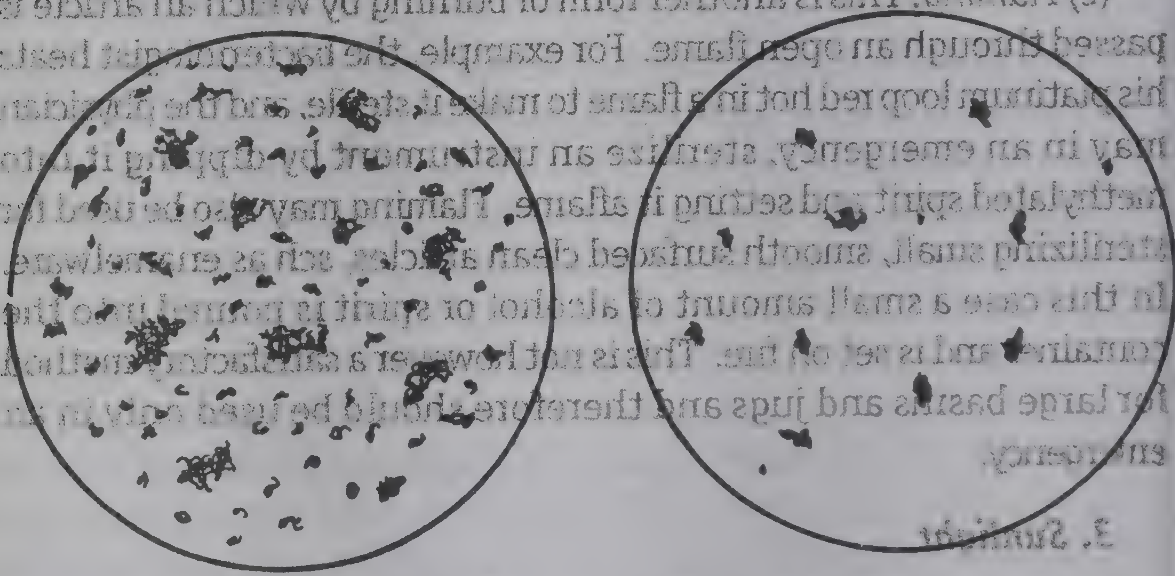


Plate showing growth of organisms in a culture of raw milk

Plate showing a decrease number of colonies after pasteurization

EFFECTIVENESS OF PASTEURIZATION

CHEMICAL METHODS OF CONTROL

A chemical disinfectant acts by coagulating the bacterial protein or by changing the composition of protein so that it no longer exists in the same form.

A good disinfectant should:

1. destroy bacteria;
2. not harm human tissue or the articles to be disinfected;
3. act quickly and penetrate the material being disinfected;
4. dissolve easily;
5. not have an unpleasant odour;
6. be easily obtainable and low in cost

Factors influencing the action of such a disinfectant are:

1. concentration of the chemical;
2. time allowed for action of the chemical;
3. nature of the material to be disinfected;
4. kind of infecting organisms;
5. heat; the higher the temperature the more active the disinfectant is likely to be.

It is important to remember that the articles to be disinfected should be completely covered with the disinfectant. Strong solutions usually act faster than weak ones but if plenty of time is available a weak solution could be better as it is less expensive. It should be remembered also that a chemical which may be disinfectant in a certain strength, may act only as an antiseptic in a weaker solution and in a very weak solution may even stimulate the growth of organisms.

COMMON DISINFECTANTS AND ANTISEPTICS

Chemical disinfectants are divided into groups according to their chemical characteristics or action. There are many chemical compounds that have a disinfectant or antiseptic action. Those that are most

often used in hospital practice will be mentioned.

Coal-tar derivatives

When coal is heated in a special manner it produces a thick liquid called coal-tar. Many useful compounds and articles have been made from coal-tar including disinfectants.

Phenol is commonly called carbolic acid. It is the compound which Joseph Lister used as the first antiseptic in 1865. It is a white crystalline compound that is dissolved in water. It is most often used in a 5 per cent solution which is bacteriocidal to vegetative bacteria and also to some spores. A 1:1,000 solution is bacteriostatic. Phenol is especially useful for disinfecting faeces and sputum or any other organic matter. It is not harmful to metal or cloth. Soap will inhibit its action. Phenol can cause severe burns to the skin and can also cause toxic effects by being absorbed through the skin. If spilled on the skin, alcohol should be applied at once as it will dissolve the phenol and wash it away more quickly than water.

Lysol is a derivative of phenol that is mixed with soap. It has a greater bacteriocidal action and is less poisonous than phenol. It can be used for the same purposes as phenol. It may be used in several strengths from 1 per cent solution to undiluted lysol depending upon the article to be disinfected. Lysol is especially useful for disinfection of articles contaminated by the tuberculosis bacilli. It must be used with care because it is caustic to the skin.

Cyllin, in black or white form, is another disinfectant of this group. It is especially good for destroying streptococci. Linen can be disinfected by soaking overnight in a 1:16 solution of white cyllin. A 1:10 solution of black cyllin, if used for a minimum of four hours is effective for disinfecting excreta. Enamelware may be disinfected by soaking as long as possible between each use in a 1:80 solution of black cyllin. Strong solutions of cyllin will stain linen and are caustic to the skin.

Chlorhexidine (hebitane) will destroy a wide range of bacteria. It is non-irritating to the skin and mucous membranes. It is very expensive, but has found wide use in being mixed with other disinfectants.

Detergents

These are chemical compounds that reduce surface tension. Some of them have good bacteriocidal power. Some of them contain a derivative of coal tar. Detergents are non-poisonous and non-irritating to the skin and mucuous membranes. However, they are expensive. The presence of soap will inhibit effective action of detergents. They are not effective against spores. Acid fast bacteria are very resistant to the action of detergents.

Centrimide is used in a 1 percent solution for antiseptic action. An alcoholic solution, colored red by a dye, is called cetavlon tincture and is used to prepare the skin for surgery.

Savlon is a combination of hibitane and cetavlon. A 1:30 dilution in alcohol is good for emergency use as it destroys vegetative bacteria in 1 to 2 minutes. A 1:200 solution is satisfactory for storing instruments. However, anti-rust tablets must be used to prevent destruction of the metal.

Fairgenol is four times more powerful than phenol. A 5 percent solution may be used for sterilizing surgical instruments. A 1 percent solution may be used as a mouth wash.

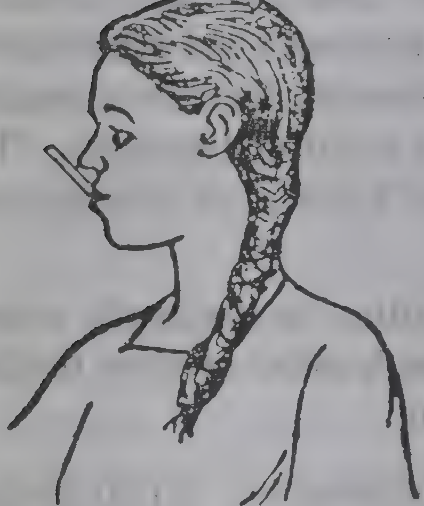
Dettol is another compound of this group that is non-poisonous and non-irritating to the skin. The cost keeps it from being widely used.

Halogens

The halogens are chemical elements that have the ability to form salts. Chlorine and iodine are two halogens that are useful as disinfectants.

Chlorine is a poisonous gas. However, it has been found useful and safe for disinfecting drinking water on a large scale because only a very small amount is needed. A concentration of 0.5 to 1 part of chlorine per million parts of water is sufficient to kill most bacteria. It is also used to disinfect water in swimming pools.

Chloride of lime or calcium hypochlorate is a combination of chlorine with calcium and oxygen and is commonly called 'bleaching powder'. Drinking water may be disinfected by using 30 gm of chlorinated lime



A contaminated thermometer

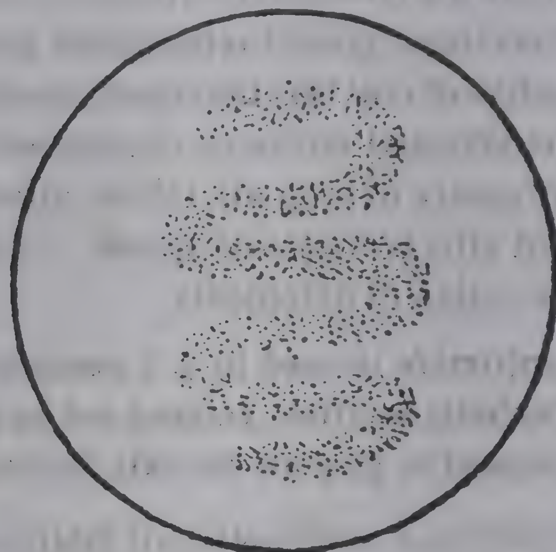
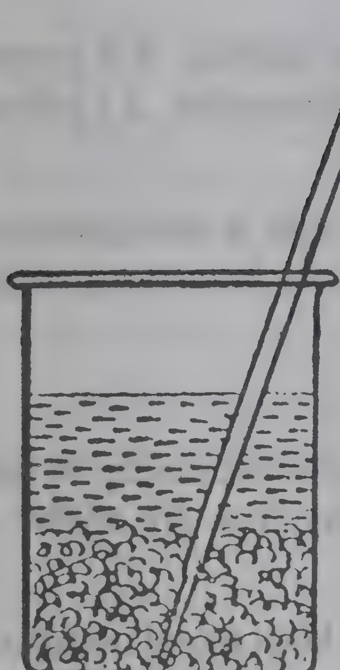


Plate showing growth of organisms in culture made from the thermometer immediately after removal from mouth



Thermometer being disinfected (**Lysol 2% for 10 minutes**)

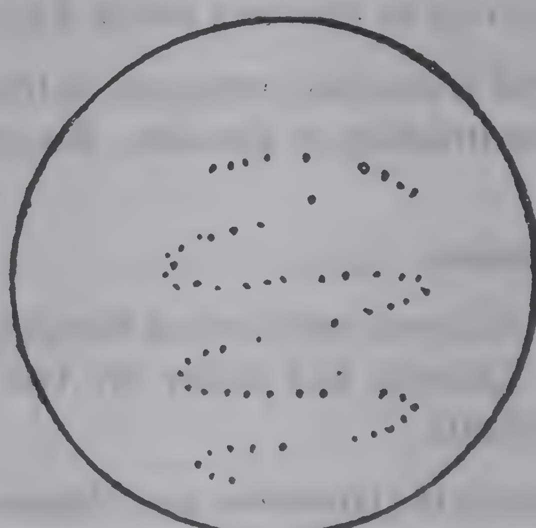


Plate showing a decrease in the number of colonies after disinfection

EFFECTIVENESS OF CHEMICAL DISINFECTION

in 8,000 litres of water. Excreta is disinfected by mixing 5% solution with equal amount of urine or faeces and after keeping the mixture for one hour, it could be emptied into sewage. Chlorinated lime does corrode metal and will destroy cloth and irritate the skin when used in strong solutions. It is unstable in solution because it quickly gives up the oxygen. Therefore, fresh solutions must be used to be effective. Chlorine has some antiseptic action and is usually used in the form of sodium or calcium hypochlorite to which may be added sodium carbonate (Dakin's Solution) or boric acid (Eusol) or it may be made more stable by keeping the reaction slightly alkaline (Milton). These solutions liberate chlorine in infected wounds and also have some action in dissolving wound debris.

Tincture of iodine is an alcoholic soluton of 1 or 2 percent iodine. It is used for cleansing the skin and treating injuries to the skin. One drop in one litre of water will kill bacteria and amoeba within 15 minutes. It is useful for purifying water in emergency situations. A solution of 6.5 to 7.5 per cent iodine is known as strong tincture of iodine.

Oxydizing agents

These compounds have the ability to kill micro-organisms because they easily give off oxygen which destroys the organisms. However, this makes them unstable and they soon lose their disinfectant power when exposed to the air. Heat and light also cause them to decompose so they should be kept in dark bottles in a cool place.

Hydrogen peroxide is a 3 per cent solution in water which may be diluted to 1.5 per cent. It is especially good for cleansing wounds where there is pus and for removing pus from infected ears. It may be used as a mouthwash.

Potassium permanganate is available in the form of dark purple crystals which are dissolved in water. It is usually used in a 1:1000 to 1:6000 strength solution. It can be used for wounds and for the irrigation of body cavities. It also has a deodorant action. It will stain the skin and cloth. When a solution of potassium permanganate turns into a brown colour it no longer has the effect as an antiseptic.

Salts of heavy metals

At the present time, compounds made of mercury are the most frequently used disinfectants from this group.

Bichloride of mercury is a very powerful disinfectant. It is usually purchased in the form of tablets which are dissolved in water. A 1:2000 solution will kill most vegetative bacteria in 1 to 20 minutes. A 1:1000 solution will kill most spores within one hour. A 1:3,00,000 solution is bacteriostatic. Albuminous material will prevent the action of bichloride of mercury. Therefore, all articles must be thoroughly washed before being put into the solution for disinfection. It will corrode metal and is irritating to the skin. It is a highly poisonous compound and must never be mistaken for water.

Metaphen is considered to be more powerful than biochloride of mercury. It is less irritating to the skin and is not poisonous. It does not harm metal instruments. It is considered satisfactory for use in the following strengths: 1:1000 to 1:5000 for instruments, 1:500 to 1:5000 for the skin, and 1:5000 to 1:10,000 for urethral and eye irrigations.

Mercurochrome is a compound containing mercury and bromide. It also contains a dye. It does not harm the skin. A 2 per cent solution is used as a skin antiseptic. A 1 percent solution may be used for infections of the urinary bladder, the eye or the ear.

Merthiolate is a mercury compound that will destroy vegetative bacteria and also fungi, but it is not effective against spores. A 1:1,000 solution may be used for disinfecting instruments or the skin. A 1:5000 or 1:10,000 solution may be used in the eye or for urethral irrigation.

This organic mercurial antiseptic is used topically and disinfecting instruments as a preservating in pharmaceutical preparations.

Dyes

These compounds have not been fully developed, but they have great value. Part of the effectiveness of mercurochrome is from the dye it contains.

Gentian violet is a dye usually used in a 2 per cent solution. It is safe to use on mucous membranes as well as on the skin. Its use is

some fungi. It is especially valuable in treating thrush, a fungus infection in the mouths of babies. Gentian violet stains on clothes are hard to remove.

Acriflavine and *proflavine* are orange coloured dyes with a bacteriostatic action against gram-positive and some gram negative organisms. The germicidal activity is not affected to any extent by serum or pus, and the compounds are used in the treatment of suppurating wounds. It is used in a 1:1000 solution for treating wounds and for irrigation of bladder and vagina.

Miscellaneous

Alcohol is different from other disinfectants in that pure alcohol has no disinfectant action. A 70 per cent solution has the greatest disinfectant action and will kill vegetative bacteria, but has no effect on spores. It is often used at concentration of a 60 to 70 per cent in water as a skin antiseptic. It can be used for thermometers, but it evaporates quickly, coagulates proteins, and is slow in action (one hour for many bacteria) so it is not often used for that purpose.

Formaldehyde is a gas that is very effective for disinfecting rooms. This is employed for fumigatoin of operation theatre and other rooms. After scaling the windows and other outlets, formaldehyde gas is generated by adding 150 grams of $Kmno_4$ to 280 ml of formalin for every 1000 cu.ft. (23.3 cu. Meter) of room volume. The reaction produces considerable heat, and so heat resistant vessels should be used. After starting generating of formaldehyde vapour the doors should be sealed and left unopened for 48 hours. This gas will kill all non-spore forming organisms and parasites such as bed bugs. There must be good amount of moisture present in the room for effective disinfection. The fumes are very irritating.

Formalin is a 37 per cent solution of formaldehyde in water. It may be further diluted for general use. A 1 to 2 per cent solution will kill vegetative bacteria in 20 to 30 minutes. It also acts as a deodorant. A 4 per cent solution will harden tissue and is used to preserve specimens.

Boric acid in a 2 to 4 per cent concentration is used as an antiseptic for the eyes and mucous membranes. It is not irritating even in

strong solutions.

Hexachlorophene (G-11) is a chemical compound that is added to soap to give it an antiseptic action. It remains on the skin even though water is used to wash away the soap. Repeated use of soap containing the compound is considered to increase its antiseptic action.

PhisoHex is the name given to a mixture of a detergent and hexachlorophene. It has been found especially good for preparing the skin for surgery and for surgical scrubbing of the hands. It remains on the skin for prolonged periods, 48 hours or more.

CONTROL OF MICRO-ORGANISMS IN THE HUMAN BODY

Chemicals which destroy micro-organisms on the skin are not satisfactory for destroying them in the internal organs and deeper tissues. Special chemical compounds are needed which can be taken into the body and carried by the blood stream without causing damage to any part of the body. The treatment of a disease by chemical compound which have specific bacteriocidal or bacteriostatic action against the micro organism causing it is termed chemotherapy. Paul Ehrlich is considered to be the father of chemotherapy since he was the first person who made a systematic and sustained effort in finding chemicals to treat diseases. Treatment for malaria with quinine and amoebic dysentery with emetine was in practice before. Ehrlich's greatest contribution in the field of chemotherapy is the discovery of salvarson in the treatment of syphilis.

Modern chemotherapy may be said to have begun in 1935 with the discovery of prontosil by *Domagk*. The development of various sulphonamides led to dramatic fall in mortality from 95% in pneumonia and meningococcal meningitis. A later drug trimethoprim was shown to potentiate the action of sulphonamides. Combination of these drugs are used widely today.

Antibacterial substances which are produced by living cells are known as antibiotics. The term is now used for synthetically produced agents also. The first antibiotic discovered by Alexander Fleming in 1928 was Pencillin, produced by a mould pencillin notatum. Pencillin

as an antibiotic was in use in 1940. By the end of World War II, pencillin was in widespread use. Streptomycin specifically effective against tuberculosis and chloramphenicol against typhoid followed. Further developments are erythromycin, gentamycin, terramycin and others.

In the preparation of antibiotics, the particular organism is grown in large tanks for a specific length of time. The culture is then filtered to remove the organisms. The filtered fluid is purified, tested and bottled under carefully controlled conditions according to established standards.

Some antibiotics act effectively against both the gram-positive and gram-negative organisms and rickettsiae. Because of this they are called 'Broad spectrum' antibiotics. E.g. Chloramphenicol, Erythromycin. They are therefore useful in the treatment of a number of diseases.

The great hopes created following the discovery of antibiotics and chemotherapeutic agents have been dimmed to a certain extent because of two untoward effects --- resistance of the micro-organisms to the drug and allergic reactions in some people. Resistance to the drug may develop due to inadequate dosage or failure of maintenance of adequate concentration of the drug in the tissues. Another consequence is that organisms such as staphylococci, pseudomonas and proteus which were formerly considered to be minor pathogens have become multiresistant and have assumed a major role in *nosocomial* (hospital acquired) infections. It is therefore important to know the antibiotic sensitivity pattern of the organism isolated from the patient before administering any one of them.

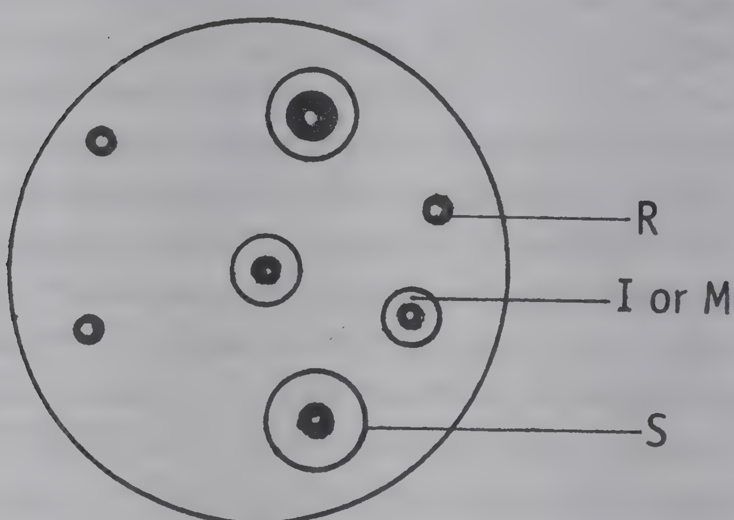
Secondly, it is important to remember that if antibiotics are given for a long time to a patient it will remove or kill the normal bacterial flora and fungi like candida which are normally present as a commensal Flora, may multiply and produce infection. This is known as superinfection.

Antimicrobial agents produce adverse reaction in some people. Therefore we should always try to get a history of previous administration of the drug. This is most important in the case of pencillin. On no account should pencillin be administered to a person

with a history of sensitivity to it. It may result in death. If it is absolutely essential to administer pencillin, a sensitivity test should be done with a very small dose. Adrenaline should be ready at hand. The adverse reactions may be of varying severity – anaphylaxis, serum sickness or contact dermatitis. Nurses are prone to develop contact dermatitis.

Antibiotic sensitivity testing is done to determine the best antibiotic with highest effectiveness against the isolated bacteria.

The test is done in the following way;- Broth culture of an isolated bacterium is spread into an agar plate and paper discs impregnated with known concentrations of different antibiotics are dropped on the surface of the seeded plate at a distance of 2 cms or more. The plate is incubated for 12 hours at 37°C. The result is read by measuring the zone of inhbition around the antibiotic discs.



Growth will be inhibited around discs containing antibiotics to which the bacterium is susceptible, but not around those to which it is resistant. The results are reported as 'sensitive', 'moderately sensitive', or 'resistant' to the different drugs.

CHAPTER 6

THE INFECTION PROCESS

When pathogenic organisms enter and multiply in the tissues of a host (human or animal) it is known as infection. Every instance of infection may not result in an infectious disease. Infection may be of various types. The first infection by a parasite in a host is known as *primary infection*. If the same parasite infects the same person again, it is called *reinfection*. When a host, already suffering from one disease caused by a parasite is infected with a new parasite the host is said to have *secondary infection*. When the infection causes disease in a particular organ or site, it is termed as *focal infection*. Eg. Appendicites.

Cross infection: When a patient who is already suffering from a disease gets a new infection from another person or source he is said to have acquired cross infection. Cross infection usually occurs in hospitals, boarding schools and hostels. When cross infection occurs in hopsitals it is called nosocomial infection. If the infection is the result of treatment or investigative procedures, it is known as iatrogenic infection.

Disease Transmission

A chain of events is necessary for the transmission of infectious disease. They are (1) a causative agent or invading organism, which may be bacterial, viral, protozoal, fungal or helminthic. (2) reservoir – a place for the invading organism to multiply, human, animal, insects, soil, water and food. (3) a portal of exit from the reservoir such as the respiratory tract and digestive tract. (4) a mode of transmission which may be direct (direct contact) or indirect through animate and inanimate vectors including fomites. (5) portal of entry of the organism into the human body such as the respiratory and gastrointestinal tract. (6) susceptible host. The presence of an infectious agent does not inevitably produce disease. When the invading organism is virulent and the host's resistant is weak infection results.

Prevention of a conmmunicable disease involves creating a break in the chain of events. Hence an understanding of the above chain of events with regard to each communicable disease is important in its prevention.

Sources or reservoirs of infection.

1. Humans

Normal body flora of a healthy individual helps to prevent colonisation by other virulent organisms. If normal conditions are altered, the normal flora may be destroyed and replaced by harmful organisms. A person who is a reservoir of such organisms may be a patient or a *carrier*. A carrier is a person who harbours the pathogenic microorganisms in the body and shows no sign of illness. Carriers are often the cause of outbreaks of infections and they may be more dangerous than the patient as nobody suspects that they are discharging pathogens. There are three types of carriers.

Convalescent carrier is one who has recovered from the disease and continues to harbour the pathogen in his body for a few weeks after recovery. This type of carrier may be called a temporary carrier. The temporary carrier state lasts less than six months.

Chronic carrier is one who continues to carry pathogens and spread the disease for a long time after recovery and sometimes even for the rest of his life.

Healthy or *contact carriers* are those who never have had any visible signs or symptoms of the disease but still may spread the organisms to others. It is possible that many persons classified as healthy carriers have suffered from a mild unrecognized attack of the infection some time or other. Examples of diseases spread through contact carriers are diphtheria, typhoid fever, paratyphoid fever, dysentery and pneumonia.

2. Animals

Many pathogenic organisms infect both man and animals. In some instances the infection in animals may not cause any disease in them but act as reservoir hosts. Diseases which are transmitted from animals

to man are called zoonosis. Zoonotic diseases may be bacterial (leptospirosis and plague from rats), viral (rabies from dogs) and protozoal (leishmaniasis from dogs).

3. Insects

Insects such as mosquitoes, ticks, mites, flies and lice that transmit infection are called Vectors. Vectors may be mechanical or biological. Mechanical vectors transmit the infecction mechanically (e.g. – typhoid and dysentery). When the pathogenic organisms multiply in the body of the vector, often undergoing part of its developmental cycle in it, it is called a biological vector e.g: Anopheles mosquito in malaria.

4. Soil and Water

The spores of some pathogenic organisms survive in soil for very long periods. E.g.: Bacilli causing Anthrax and Tetanus, Fungi such as Histoplasma Capsulatum survive in soil and cause infections. Worm infestation such as hookworm and roundworm spread through soil.

Water contaminated by pathogenic organisms such as Vibrio Cholerae and hepatitis A serve as a source of infection.

5. Food

Infected or contaminated food serve as a source of infection e.g.: infected pork.

Portals of entry

There are certain gates or pathways by which microorganisms enter the body. These are known as *portals* or *entry*. Most of the pathogenic organisms can cause disease only if they enter through their particular portal. For example, if dysentery bacilli are rubbed into a wound on the skin they may not cause any trouble but if the same organisms are swallowed, they are almost certain to cause dysentery.

1. Skin and Mucous Membranes

A large number of organisms are always present on the skin but most of them do not penetrate the unbroken skin. However, staphyococci and some of the fungi are able to penetrate under certain

conditions and cause disease in the deeper tissues. Insect and animal bites, injection with contaminated products, trauma or sexual contact are other ways in which microorganisms enter the body through the skin e.g: Rabies, malaria, hookworm.

2. Respiratory tract

The air around us contains micro organisms which have been spread widely during coughing, sneezing or talking and these may enter into the respiratory tract with the air inhaled, e.g: organisms causing colds, influenza, pneumonia and pulmonary tuberculosis.

3. Digestive tract

Micro organisms enter the body along with food and water. The organisms which cause typhoid, dysentery, cholera and hepatitis enter in this way.

4. The Genitourinary tract

Generally urinary tract infections (UTI) are caused by bacteria from urethra, perineum, etc., travelling upwards (ascending infection) and sometimes introduced through catheterization. UTI can also be through the blood. Venerial diseases of the genitourinary system such as gonorrhoea and syphillis are acquired through sexual contact and transmission.

5. Infection through inoculation

Infection by inoculation may occur by the use of unsterile syringes, injuries allowing tetanus spores, blood transfusion and inoculation of infected blood by insects as in malaria.

PORTALS OF EXIT

Very often organisms leave the body through the same system by which they entered. The organisms causing respiratory disease are usually given off through the nasal discharge and sputum. Pulmonary tuberculosis, pneumonia and diphtheria are examples. Organisms which enter the digestive system through the mouth usually leave the body in the faeces through the rectum. This is true of typhoid, cholera

and dysentery.

Organisms that enter the body through the skin often produce pus and leave through the skin in the pus. Staphylococci and some other organisms enter through the skin and produce pus. They then leave in the pus through the skin. Some diseases, such as malaria and yellow fever, occur because the organism enters through the skin into the blood during the bite of a mosquito. The organisms leave by the same way when a mosquito sucks blood from a person with the disease. Malaria, syphilis, hepatitis B and Acquired Immunodeficiency disease can also leave the body through blood used for transfusion.

Typhoid bacilli may leave through the urinary tract. Syphilis and gonorrhoea organisms usually leave through the genitourinary tract.

There are a number of exceptions where the microorganism leaves the body by a route, different to the one by which it entered. A good example is the rabies virus which enters through the skin, but leaves through the saliva.

METHODS OF TRANSMISSION OF MICROORGANISMS

In order to produce infection the organism has to be transferred from an infected host to a new host. This may be brought about by any one of the following method:

1. Direct Infection

Infection may be transmitted directly from person to person either by direct contact with the infected person or by contact with the secretions and excretions of the infected person. For example, organisms causing diphtheria, common cold and tonsillitis may be transferred by kissing. Sexually transmitted diseases including hepatitis B and AIDS are usually transmitted by direct sexual contact with the infected person. A nurse may contract typhoid fever or dysentery by soiling her hands with the faeces of a patient and not taking care to wash her hands before she prepares her food or before eating with her fingers.

A special type of direct infection is known as *droplet infection*. Microorganisms are thrown out into the air by coughing or sneezing fine droplets of saliva and mucus. They may be thrown as far as 3 ½ feet while talking or up to 10 feet when sneezing. Droplet nuclei and dust containing a variety of organisms may be carried by the air. This is a major way by which the organisms which cause colds, influenza, pneumonia, diphtheria and tuberculosis are spread.

2. Indirect infection

Infection may be acquired indirectly through articles which have been recently contaminated. These articles which are likely to carry the disease organisms, are called *formites* and would include such things as bed linen, handkerchiefs, drinking cups and eating vessels. Organisms causing gastrointestinal and respiratory infections may be transferred through formites. Contamination of water by sewage and contamination of milk by the milk handlers are other examples of indirect infection.

3. Infection by inoculation

This may occur by the use of unsterile syringes, injuries allowing tetanus spores, blood transfusion and inoculation of infected blood by insects as in malaria.

Normal Microbial Flora of the Human Body

Human beings are not sterile as far as microorganisms are concerned. The normal microbial flora refers to the population of microorganisms that inhabit the skin and mucous membrane of healthy normal persons. The normal body flora of healthy individuals vary from one person to another, depending on age, general health, temperature and specific local conditions such as acidity in the stomach. The normal body flora actually help to prevent infection/colonisation by other pathogenic organisms. The microflora of the intestinal tract synthesise vitamins such as vitamin K and B.

The normal body flora can be of two types namely (a) Resident flora (b) Transient flora. The resident flora consists of relatively fixed types of microorganisms regularly found in a given area at a given age. Transient flora consists of non-pathogenic microorganisms that

inhabit a particular part of the body for a limited period. Many pathogenic organisms normally do not cause disease but are opportunistic. They cause disease when the normal flora is destroyed or body defence is weakened as in Diabetes Mellitus and Immunodeficiency states. Some organisms are harmless in their natural resident area but cause disease in another area eg. E. Coli is harmless in the colon but are pathogenic in the Urinary tract.

The sites in the body which are normally sterile are bone marrow, blood, cerebrospinal fluid, serous fluids, tissues, urine, lower respiratory tract, middle and inner ear. Sites with normal flora are the skin, upper respiratory tract, gastrointestinal tract female genital tract and conjunctiva.

Hospital infection (Nosocomial Infection)

Nosocomial infections are infections which develop during hospitalization and were not incubating or present at the time of admission of the client to the hospital. Hospital environment is heavily laden with pathogenic organisms and when patients are admitted to the hospital they come with lowered vitality and resistence power. Transmission usually occurs via the hands of hospital personnel, respiratory droplets, food, drinking water, contaminated surface areas, catheters and equipment used in life-support systems and diagnostic procedures.

Common types of hospital infections

1. Urinary tract infection

Escherichia coli and other Gram negative bacilli are the causative agents. The infefction usually results from catheterization and indwelling catheters. Strict asceptic technique minimizes the infection.

2. Respiratory infections

Aspiration in unconscious patients and pulmonary ventilation or instrumentation may lead to nosocomial pneumonia. Multidrug resistant staphylococci aureus and Gram negative bacilli are the common pathogens. Antibiotic treatment is useful in prevention and management of such cases.

3. Wound infections

Organisms causing wound infections in hospitals are staphylococcus epidermis, streptococcal pyogenes and clostriduim. Surgical wound infections are mostly due to organisms introduced during operative procedures in the operation theatre, wound dressings and other invasive procedures.

4. Bacteraemia and septicaemia

These may be consequences of infections at any site but are commonly caused by the infected intravenous cannulae left in place for several days. Strict aseptic technique and minimized use of intravenous therapy will reduce the infection.

5. Hepatitis B and AIDS

These are serious risks for patients receiving blood transfusions or undergoing renal dialysis. It is also a major risk for hospital personnel.

6. Food poisoning

Acute gastroenteritis from Salmonella food poisoning, staphylococcal contamination of cooked food and out breaks of diarrhoea due to Escherichia coli are examples of acute gastro enteritis.

The microorganisms causing common hospital infections include Escherichia coli, staphylococcus aureus, Pseudomonas aeruginosa, Hepatitis B virus, candida albicans (yeasts), Aspergillus (moulds), Entamoeba histolytica, Pneumocystis carini, Toxoplasma gondie (protozoa), antibiotic resistant Staphylococcus aureus and various other gram-negative bacilli.

Diagnosis and Control of hospital infection

Astiological diagnosis of hospital infection is made by routine bacteriological methods of smear, culture, identification and sensitivity testing. Sterilization techniques have to be tested. There should be an infection control team in every hospital consisting of microbiologist, medical and nursing staff and hospital administrators. Every outbreak of infection should be investigated. Isolation technique should be strictly followed when admitting and caring for

patients with communicable disease. Education of patients and relatives regarding the control of infection should be part of the care. Infection control should not be based on the use of antibiotics. *Soap, water and commonsense are the best disinfectants* said Sir William Osler. And it is very true today when we are fighting against more and more drug resistant microorganisms.

Collection and disposal of hospital waste should be on scientific basis. Incineration is the best method of disposing waste especially those contaminated with blood and other body fluids. Control of infection should be aimed at prevention of transmission. This can be done by the following methods.

1. Remove the source of infection either by treatment and/or sterilization of contaminated articles.

2. Protecting the susceptible host by immunization when necessary or applicable; screening of hospital personnel where relevant and in surgery by sterilization of all objects coming in contact with the patient's tissue and with minimal handling of the latter.

3. Blocking the lines of communication which will not permit transmission; by isolation of infected or highly susceptible patients, use of hand washing and strict aseptic techniques, control of carriers and scrupulous hygiene in all hospital areas including food preparation, waste disposal, laundry services and house keeping programme.

CHAPTER 7

INFECTION AND RESISTANCE

Infection results from the successful entrance into the body of microorganisms and their growth and multiplication in the tissues. Microbes capable of causing infections that result in disease are called pathogens. The simple fact that microorganisms have entered the body does not mean that infection will result, for this depends on (1) the portal of entry (2) the virulence or ability of the organisms to produce disease or pathologic effects (3) the number of organisms and (4) the defensive powers of the body.

How Microorganisms cause Disease

The microorganisms which enter the body produce diseases in different ways. In certain cases, the disease is due to the mechanical effects, such as filling up of tissue spaces and capillaries by the multiplying bacterial cells. This process of multiplication of micro organisms and spread in tissue is called invasion. In other cases infection is due to the poisons, known as toxins, that are produced by the organisms. Toxins are of two types, (1) endotoxin which remains enclosed within the cell membrane until the organism dies and breaks up, as found in gonococci and typhoid bacilli. (2) exotoxin which diffuses out through the cell membranes into the surrounding medium or tissue, e.g. diphtheria bacilli and tetanus bacilli.

Protection Against Bacteria

General defenses

The body has mechanical, physiological and chemical method of protecting itself against microorganisms. The skin and epithelial tissues lining the body cavities are a very important protection. Most organisms cannot enter through healthy unbroken skin or tissue, but can enter if there is even a small abrasion or injury.

Cilia in the nose act as a filter to prevent many organisms from entering the lungs. The structure of the nasal cavity also acts as a trap in catching some dirt and organisms. The presence of any irritating substance in the air passages produce sneezing or coughing which removes many organisms.

The genitals are protected by a thick layer of epithelium and by acid secretions from glands in the area.

Mucous surfaces of the nose, mouth and vagina prevent bacteria from entering the body by entrapping them, with their sticky secretions, other secretions like tears wash them away. Yet others like gastric juice and vaginal secretions inactivate the microorganisms with chemical action.

General influences include general health, state of nutrition, metabolic activity, hormonal influences and genetic factors.

Non-specific defence mechanisms also include inflammation, phagocytosis, complement system, interferon, opsonins, interleukins etc. Inflammation is the protective response of the tissues of the body to irritation or injury or an antigen.

In the process of phagocytosis, phagocytic cells ingest invading organisms and destroy them with enzymes. The neutrophils and monocytes are involved in phagocytosis. Fixed phagocytes which do not circulate include fixed macrophages and the cells of the reticulo-endothelial system. Free phagocytes which circulate in the blood stream include the leucocytes and the free macrophages. In many acute infections, there is an increase of white blood cells (leucocytosis) and a high percentage of poly-morphonuclear cells.

Interferons are a family of natural cellular proteins produced by cells of the immune system. They appear to be the first line of defence against viral infection. They have antiviral and antitumour properties.

Interleukins are proteins with numerous immune system functions including activation of resting T cell lymphocytes. They also induce non-specific resistance to infection.

Complements are circulating plasma proteins which are made in the liver and activated when an antibody couples with an antigen and

helps in the destruction of infecting organisms.

In opsonization the antigen antibody molecule is coated with a sticky substance which help in phagocytosis.

Specific defence mechanism

Specific defences come into play once microorganisms gain entrance into the body breaking through the general defence barriers. The immune response to an antigen can be of two broad types namely the humoral or antibody mediated immunity and the cellular or cell mediated immunity. Humoral immunity is mediated by antibodies produced by plasma cells and cellular immunity is mediated by sensitized lymphocytes.

Antigen

Any substance which is capable of inducing the formation of antibodies and producing specific and observable reaction with the antibody so formed is known as an antigen.

Antigen may be microorganisms, their toxins or any foreign protein. Antigens stimulate the production of specific antibodies or cell mediated immune response. Antigens function in two ways (1) induction of immune response (immunogenicity) (2) specific reaction with antibodies or sensitized cells (Immunological reactivity).

Antibodies are specific in nature which means that they react only with the particular organisms or toxins or proteins which caused their formation. All antibodies are immunoglobulins but all immunoglobulins are not antibodies. In human beings the sera contains five classes of immunoglobulins (Ig) namely Ig Q, Ig A, Ig M, Ig D and Ig E.

Antibodies affect the organisms in different ways and are named accordingly (a) Bacteriolysins cause dissolving or destruction of bacterial cells (b) agglutinins cause the bacteria to stick together or clumped (c) precipitin causes the formation of an insoluble precipitate of antigen and antibody combination (d) opsonins help and increase phagocytosis of the affected organisms.

Antigen-antibody reactions normally produce immunity, but they can also produce allergy, autoimmunity etc.

The response of the body to some of the antigens is not protective but is harmful to the host. Such response is referred to as hypersensitivity reactions. These include immediate or anaphylactic hypersensitivity, or delayed hypersensitivity occuring after 24 hours or more.

Autoimmunity is a condition in which the damage is produced by the action of immunologically competent cells or antibodies against normal components of the body eg: pernicious anaemia, Guillian Barre syndrome, Myasthenia gravis and systemic lupus erythematosus.

Immunodeficiency diseases are conditions where the defence mechanisms of the body are impaired, leading to repeated microbial infections.

Immunity

Immunity refers to the ability of an organism to recognise and defend itself against infectious diseases. It is the quality of being unaffected or unsusceptible by particular organisms. Susceptibility means the vulnerability of the organism to harm by infectious agent and is the opposite of immunity.

Immunity gives the power to resist and overcome infections caused by particular organisms. The resistance is produced by the action of antibodies and other cell mediated immunity against the organisms or by phagocytes destroying the organisms. In certain cases antibodies and phagocytes work together in fighting and overcoming the organisms.

There is some immunity present in every individual at birth. This is called innate or natural immunity. There are several ways in which immunity develops in the body after birth.

Immunity

1. Innate		
	a. Nonspecific	Species
		Racial
		Herd
		Individual
	b. Specific	Species
		Racial
		Individual
2. Acquired		
	a. Active	Natural
		Artificial
	b. Passive	Natural
		Artificial

Innate Immunity

There is a great difference in susceptibility among various species of animals. Most of the diseases that are common among human beings do not affect lower animals. For example, birds do not become infected with the same type of tubercle bacilli that affect cattle and man. This is known as species immunity.

Certain groups of people are naturally resistant to some diseases. Hebrews are more resistant, to tuberculosis than other people. This is called racial immunity.

Some authorities believe it is possible that some people have a strong natural resistance or immunity to certain diseases. This is referred to as individual immunity.

Herd immunity is the immunity developed in a community or a group of people where a large number of people (80%) develop

resistance to a particular disease. Herd immunity implies group protection beyond that which is offered by the protection of immunized individuals in the community. Herd immunity helps to limit the spread of epidemics.

Acquired immunity

The resistance that an individual acquires during his life is known as acquired immunity. Immunity may be active or passive, acquired naturally or artificially. It is naturally acquired by suffering from the disease. The specific immune defences are of two types:

1. Active immunity

a. Humoral immunity

b. Cellular immunity

c. Combination of the above

2. Passive immunity

a. Normal human Immunoglobulin (Ig)

b. Specific human Immunoglobulin (Ig)

c. Animal antitoxins or antisera

Active immunity is the resistance developed by an individual as a result of an antigenic stimulus. This involves the active functioning of the person's immune system leading to the synthesis of antibodies or the production of immunologically active cells. Active immunity may be acquired in 3 ways.

a. Following clinical infection. Eg. Chickenpox, rubella and measles.

b. Following subclinical and in apparent infection eg. Poliomyelitis and diphtheria

c. Followiong immunization with an antigen which may be a killed vaccine, a live attenuated vaccine or toxoid.

The immune response

a. The primary response

Three to ten days after the administration of an antigen to an animal or human, antibodies appear in the blood. The antibodies formation reaches a peak in 7 – 10 days and gradually falls over a period of weeks or months. An important outcome of primary antigenic stimulation is the production of "memory cells" by both B and T lymphocytes of the reticuloendothelial system.

These cells are responsible for the "immunological memory" the purpose of immunization is to develop immunological memory.

b. Secondary (Booster response)

The response to a booster dose is faster in producing the antibodies. This accelerated response is attributed to immunological memory. Collaboration between B and T cells is necessary to initiate a secondary response. The immune response (primary and secondary) and immunological memory are the basis of vaccination and revaccination.

Cellular immunity is responsible for immunity against many diseases including tuberculosis, brucellosis and also for the body's rejection of foreign material, such as skin grafts.

The humoral response primarily defends against bacteria and viruses present in body fluids. The cellular response is primarily against intracellular viruses, fungi, protozoa, helminths, transplanted tissues and cancer cells.

For vaccines to be effective, they must elicit both humoral and cell mediated responses.

Passive immunity

When antibodies produced in one body (human or animal) are transferred to another to induce protection against disease it is known as passive immunity. Passive immunity may be induced by:

a. administration of an antibody-containing preparation (immunoglobulin or antiserum)

b. transfer of maternal antibodies across the placenta.

Immunizing agents

The immunizing agents may be classified as vaccines, immunoglobulins and antisera.

1. Vaccines

Vaccines are immuno-biological substances designated to produce specific protection against a given disease. It stimulates the production of protecting antibody and other immune mechanisms. Vaccines may be;

a. *Live vaccines* eg: BCG, measles, oral poliomyelitis.

These vaccines are prepared from live attenuated organisms. Live vaccines should not be administered to persons with immuno-deficiency diseases.

b. *Inactivated or killed vaccines* eg:- typhoid, cholera, rabies and hepatitis B.

Killed vaccines usually need 2 or 3 primary doses to be followed by booster doses.

c. *Toxoids:* Certain organisms produce exotoxin and these toxins are detoxicated and used in the preparation of vaccines.

The toxoids are efficient and safe immunizing agents.

E.g. – diphtheria and tetanus toxoids.

d. *Combinations:* If more than one immunizing agent is included in the vaccine, it is called a mixed or combined vaccine. Eg. DPT (Diphtheria, Pertussis and Tetanus)

2. Immunoglobulins (antibodies)

Two types of immunoglobulin preparations are available for passive immunization. These are (a) Normal human immunoglobulin and (b) Specific (hyper-immune) human immunoglobulin. These are used in the prophylaxis of viral and bacterial infections and in replacement of antibodies in immunodeficient patients.

3. Antisera or antitoxins

When immunizing agents are prepared from the serum of animals, it is termed as antisera. Passive immunization achieved by antisera or antitoxins prepared from non-human sources are still the main source of passive immunization against tetanus, diphtheria, botulism, gas gangrene and snake bite. Antisera may occasionally give rise to serum sickness and anaphylactic shock due to abnormal sensitivity of the recipient.

The Cold chain

The *Cold chain* is a system of storage and transport of vaccines at low temperature from the manufacturer to the actual vaccination site. Vaccine failure may occur due to failure to store and transport under strict temperature controls. Hence it is necessary to store all vaccines at the temperature recommended by the manufacturer usually between 4 and 8 degrees celsius.

Expanded Programme of Immunisation (EPI)

The Ministry of Health of the Government of India has established the WHO's EPI launched in 1974 in order to intensify and streamline national efforts to immunise increasing proportions of children against 6 target diseases. They are tuberculosis, diphtheria, pertussis, tetanus, poliomyelitis and measles. The vaccines are centrally procured and distributed to the state level EPI manager for implementation. Following the eradication of smallpox globally, WHO has now launched a programme for eradication of poliomyelitis by the year 2000 A.D.

In addition to the EPI, a large number of private institutions and practitioners purchase vaccines commercially and immunise children either as free service or on payment. Immunization against Hepatitis B is now available.

IMMUNIZATION SCHEDULE

Age	Vaccine	Remarks
At Birth	Zero dose OPV	
	BCG	
1 ½ months	DPT	
	OPV	
2 ½ months	DPT	
	OPV	
	Hepatitis B Vaccine	
	1 dose (optional)	
3 ½ months	DPT	
	OPV	
	Hepatitis B Vaccine	
	II dose (Optional)	
9 months	OPV,Measles	
	Hepatitis B Vaccine	
	III dose (optional)	
15 months	MMR	
1 ½ years	DPT	
	OPV I Booster	
4 ½ years	DPT	
	OPV II Booster	

Immunisation of antenatal mothers with two doses of tetanus toxoids at one month's interval has become part of antenatal care.

The above schedule should be used as a guideline. Modifications may be made according to local conditions. BCG may be given at birth or at any age thereafter. If there is a break in the schedule, there is no need to re-start from the first dose. On the other hand, the break is to be ignored and immunisation continued as though there was no break.

CHAPTER 8

A STUDY OF A FEW PATHOGENIC BACTERIA

THE PATHOGENIC GRAM-POSITIVE COCCI

It has been mentioned that the cocci arrange themselves in different ways. In irregular clusters (staphylocci) or in the form of a chain (streptococci), or in pairs (dipolococci). The cocci may be classified still further according to their staining reactions and the change they produce, when grown in certain culture media. We shall consider here a few of the pathogenic Gram-positive cocci.

Staphylococcus epidermidis (albus)

These organisms produce white colonies when cultured. It is commonly found on the skin and is quite harmless as long as there is no injury to the skin. Certain skin disorders such as pimples, acne and infections of stitches (stitch abscess) are usually caused by Staphylococcus albus. Though it does not form spores, it is comparatively resistant to drying and can remain alive for a long time outside the body.

Staphylococcus aureus

These are gram-positive cocci measuring around .7 to 1.2 μ in diameter arranged in grape like clusters. They produce golden yellow pigment ('aureus' means 'gold') when grown in culture media. Staphylococcus aureus is the pathogenic staphylococci. Their virulence is due to the production of an important enzyme called coagulase and other enzymes and toxins by Staphylococcus aureus. Toxic shock syndrome (TSS) is a manifestation of infection by staphylococci, producing enterotoxin. Staphyloesccus aureus is the causative organism of many infections, e.g. boils, carbuncles, fatal septicaemia, osteomyelitis, whitlow, tonsillitis, pharyngitis, sinusitis, pneumonia and breast abscess. Staphylococcus aureus is a very common cause of infection acquired in the hospital. It is most liable to infect new born

babies, surgical patients, elderly and malnourished persons and patients with diabetes and other chronic diseases. Many people are carriers of Staphylococcus aureus and it is very important to detect these people, more so, if they are working in the hospital wards. Careful handling and disposal of dressings are important. Boiling and use of disinfectants such as tincture of iodine, 5 per cent phenol and 5 per cent lysol can kill the organisms in a few minutes.

Staphylococci may also be the cause of a common type of food 'poisoning' as they grow easily in many foods like milk and custard and produce a toxin. This food poisoning is due to an enterotoxin produced by some strains. When swallowed, this toxin causes nausea, vomiting and diarrhoea. Thorough washing of hands before preparing food is important in the prevention of this illness. Large number of Staphylococcus aureus are resistant to Pencillin and other commonly used antibiotics. Multidrug resistant staphylococcal aureus infection is one of the very serious hospital infections.

Streptococci

Streptococci are Gram-positive cocci, non-motile and cause pyogenic infection. Streptococcus pyogens are non-spore forming and are easily destroyed by heat (54 C for 30 minutes) but may remain alive in dried sputum or other exudates for several weeks. They require enriched media for growth. On the basis of the reactions they produce when grown on blood agar medium, they are divided into three categories namely Haemolytic streptococci, Streptococcus viridians and non-haemolytic streptococci. Haemolytic Streptococci are the most pathogenic causing pyogenic infections. Some produce exotoxins which add to their virulence. Diseases which may be caused by streptococci are tonsillitis, endocarditis, bronchopneumonia, scarlet fever, puerperal fever, and skin infections. The organisms may be found in smears and cultures made from pus and may be isolated from blood cultures when there is septicemia, Tonsillitis or pharyngitis caused by streptococci may be followed by rheumatic fever and rheumatic heart disease. Streptococcal tonsillitis and skin infection can cause acute nephritis in children. Streptococcus faecalis produce urinary tract infections and endocarditis. Streptococci are sensitive to Penicillin and is the drug of choice.

Pneumococcus

This organism has a lancet shape and a capsule and usually occurs in pairs but sometimes it forms short chains also. Pneumocci are Gram positive and non-motile. They can be cultivated on enriched media such as blood agar. Like the streptococcus it may be easily killed by heat and disinfectant such as 1:1000 bichloride of mercury, 5 per cent phenol and 5 per cent lysol. Diseases caused by pneumococci are lobar pneumonia, meningitis, peritonitis and occasionally puerperal sepsis. In a patient with pneumonia, the pneumococci are found in the saliva and sputum, so great care should be taken to disinfect all articles which may possibly be contaminated by sputum or saliva. The proper disposal of sputum and disinfection of sputum cups are essential to prevent the spread of infection. Pneumococcal infections are easily treated with Penicillin, Erythromycin etc.

GRAM-NEGATIVE COCCI

Neisseria Gonorrhoeae (Gonococci)

This is a gram-negative diplococcus. It is coffee-bean-shaped and always occur in pairs with the flat surfaces opposite to each other. It dies quickly outside the body and can be killed easily by light, heat and disinfectants. Gonorrhoea, which is an infection of the urethra and reproductive organs in both men and women is caused by the gonococcus. The disease is transmitted by sexual contact and by contact with the discharges. A woman with gonorrhoea who gives birth to a child may infect the new-born baby's eyes during the process of delivery. This condition is called ophthalmia neonatorum.

Neisseria meningitis (Meningococci)

This is another gram-negative diplococcus and resembles the gonococcus in many ways but shows more irregularity in shape and size. It can be killed very easily outside the body. The meningococcus is one of the organisms which causes inflammation of the meninges. Meningitis caused by meningococci is usually common in temperate zones. In India meningitis caused by meningococci is rare. Meningitis in India is more often produced by pneumococci and Haemophilus influenzae. Neisserial infections are treated with Penicillin.

GRAM-POSITIVE BACILLI

There are a number of organisms in this group and they differ very much in their characteristics and the disease they produce in man. A few which are of medical importance and of importance to the nurse will be discussed here.

Clostridium Welchii

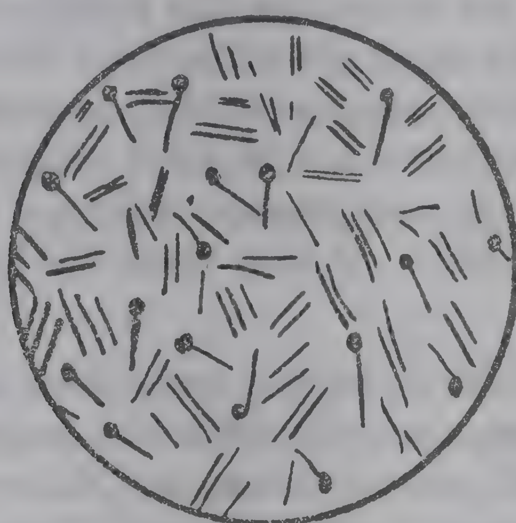
These are gram-positive bacilli of 4 to 6 x 1μ size which cause a condition called gas gangrene, so called because of much gas produced in the infected tissues. This organism is an anaerobe and lives and multiplies in tissues following wound contamination. The gas produced leads to further destruction of the tissues. Being strictly anaerobic the organism usually grows in deep and dirt soil contaminated wounds. Clostridium Welchii is normally present in the intestinal tract of human beings and animals and is likely to be found in the soil. Gas gangrene of infected wounds may be prevented by careful cleaning of all deep, dirty, wounds and by keeping them as open as possible. It is good to allow the wound to heal from the bottom upward. after all the dead tissue has been removed passive immunization with antitoxin is believed to be of some of use and it is often combined with tetanus antitoxin for administration. Precaution should be taken against hypersensitivity. Some type of Clostridium Welchii can cause food poisoning.

Clostridium tetani

The spores are terminally situated giving the organism a drum stick like appearance. Like Clostridium Welchii this organism is anaerobic and is also found in the normal intestinal tract and is dangerous only when it gets into deep wounds. The spores formed by this organism may remain alive for a very long time. When it grows in dead tissue, the organism produces a toxin which is a deadly poison. The toxin acts on the nerves which supply the muscles and produces the symptoms of the disease 'tetanus' or 'lock jaw'. The use of antitoxin is very valuable for prevention of the disease. As mentioned before, it is a common practice to give a dose of antitetanic serum to a patient with any wound in which the tetanus bacilli are likely to develop. If the person is not already actively immunized with tetanus toxoids. A

booster dose of toxoid is given if injury occurs three years or more after the course of immunization. Antibiotics have to be administered to prevent formation of new toxin. Careful treatment of wounds as in the case of gas gangrene is also essential for the prevention of tetanus.

Vaccination with toxoid is effective for production of active immunity and prevention of infection.



CL.TETANI WITH AND WITHOUT SPORES

Clostridium botulinum

This organism is much like the Clostridium Welchii in certain characteristics. It is 5 x 1μ in size. Being anaerobic it can grow well in tinned foods which are packed without air where it produces its powerful toxin. If the food is not heated enough to destroy the toxin before it is eaten severe food poisoning may be caused. Boiling for 15-20 minutes destroys the toxin. There is an antitoxin against this organism which is of value if given before the beginning of symptoms.

Bacillus anthracis

This is another spore-forming gram-positive organism but it is a strict aerobe. It measures 3-10 x 1-1.6μ. It causes disease among sheep and cattle and occasionally in humans. It enters into the body through cuts and wounds and forms a pustule at the site of infection and is then absorbed into the blood stream. It may be breathed in or swallowed also. Anthrax infection is more common among those who work in wool and leather industries. All the discharges and dressings

should be disposed of properly as these organisms are highly virulent and their spores very resistant.

BACILLI ASSOCIATED WITH RESPIRATORY INFECTIONS

Corynebacterium diphtheriae (Klebs – Loeffler Bacillus)

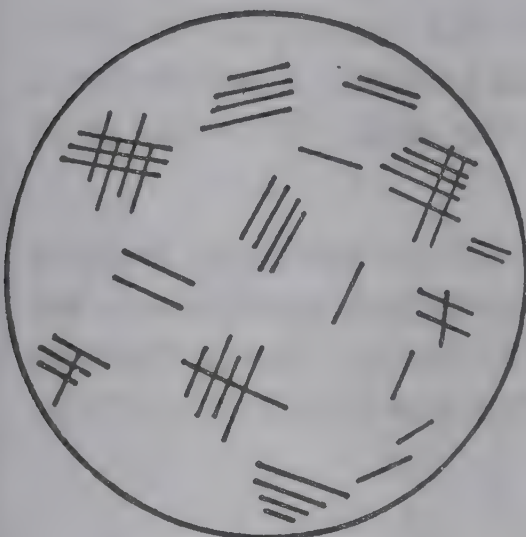
This is a Gram Positive rod shaped organism of size 3-6μ in length. When seen under the microscope this organism may appear curved with dots at the end which give it the shape of 'dumbbells', or it may appear club-shaped with irregular staining, or slender and barred. When present in moist material it may be killed easily by heat. The bacillus is found in the throat, nasal passages and upper respiratory tract of a person with diphtheria. It may enter the respiratory tract via inhalation.

When it enters into the body, it settles down in the throat or parts nearby and produces a powerful toxin as it grows. This toxin causes injury to the heart, nervous system and kidneys, and often causes death. Proper disposal of saliva and nasal discharges is important in the prevention of spread of this disease. Missed cases, carriers and contaminated milk are other sources of infection. The disease may be prevented by active and passive methods of immunization. The Schick test, which has been mentioned previously, is carried out to test for immunity to the diphtheria toxin. In many countries, it is possible now to give all the children a permanent protection against diphtheria by the use of toxoids. The passive method of immunization is used as a temporary measure when a person has had contact with the disease. Antitoxin, which gives protection for two to three weeks, is injected. Antitoxin is also used in treatment to prevent damage by the toxin.

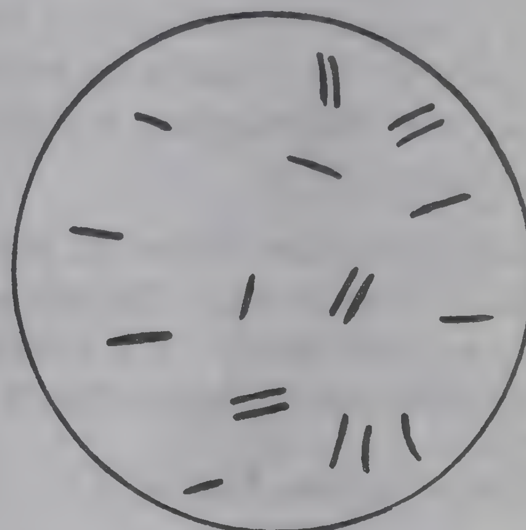
Mycobacterium tuberculosis

Organisms of this species are slender rods, sometimes curved, which have a beaded appearance. The size is 1 to 4 x 0.2 x 0.8μ. Special methods of staining must be used in the laboratory to find out the tubercle bacilli, since these organisms have a waxy cell wall which resists the usual stains. Once stained, however, even the application of acid-alcohol cannot remove the stain. Because of this property they are called 'Acid-fast Bacilli'. Though the tubercle bacilli are non-

spore-forming, they are resistant to heat, disinfectants and drying. In dried sputum they can live for months.



Mycobacterium leprae



Mycobacterium tuberculosis

There are two main varieties of tubercle bacilli. One is the human kind which affects human beings only, and the other is the bovine type which affects both cattle and human beings. The bovine type is more common among children as they are liable to get the infection through milk from the diseased cows. The tubercle bacilli can affect any part of the body, such as bones, glands, etc. and their portals of exit depend on the organs affected. For example in a patient with pulmonary tuberculosis or tuberculosis of the lungs the organisms may be found in the urine. The nurse taking care of the patient should give special attention to the disposal of the particular excretion or secretion in order to prevent the spread of the infection.

If a person has tubercle bacilli in his body or is in prolonged contact with it, he will become sensitive or allergic to the organism and to the tuberculin it produces. Some authorities believe a person who has developed a sensitivity to the organism has more resistance to the disease. Tests may be done to determine if a person has the sensitivity. The test done more frequently is the Mantoux. These are two different preparations of the tuberculin that may be used in doing

this test. One is known as 'Old Tuberculin' as it was the first used. Now a more purified form of tuberculin is used. It is called P.P.D. (purified protein derivative). A very small amount of the diluted tuberculin is injected into the skin. If a person has become sensitive to the organism, he will develop redness and swelling at the site of the injection. He is said to be 'tuberculin positive'. A person who is not sensitive will show no reaction on the skin. He is said to be 'tuberculin negative'.

Many authorities believe all persons who are tuberculin negative should be given vaccine. The vaccine is made from greatly weakened bovine tubercle bacilli. It is called B.C.G. vaccine (Bacilli Calmette Guerin) in honour of the two French doctors who discovered it (1921).

Mycobacterium Leprae

This is another acid-fast bacillus very similar to mycobacterium tuberculosis. The size is 5 x 0.5 μ. It is responsible for causing leprosy. The method of transmission of the organism is not known clearly. Some authorities think it may enter through the skin. Others believe it is more likely to enter through the mucous membrane of the nose and throat. The breathing in of bacilli laden droplets or dust is at present regarded as the most likely way of entry of leprosy bacilli into contact persons. The organism enters sensory nerves. This results in damage to the muscles. Sometimes other portions of the body are affected. The mycobacterium leprae is not cultured yet multiplies in mice foot pad. Research is being done to find a suitable vaccine to prevent the disease. At present there is none available. Recommended multi drug therapy for leprosy include Rifampicin, clofazimine and dapsone.

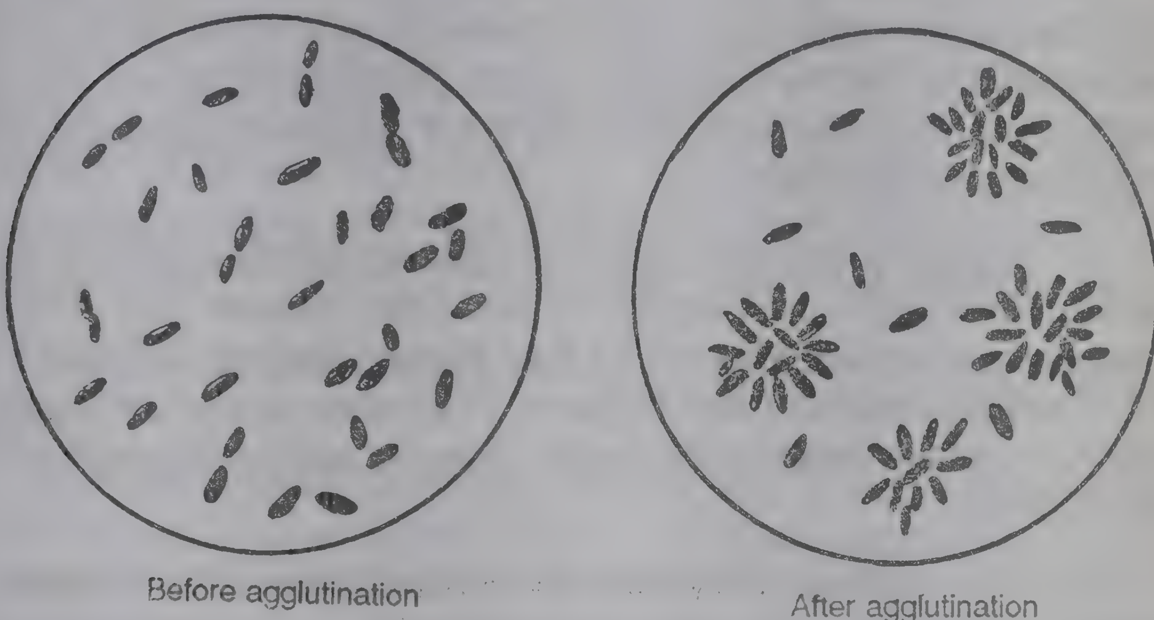
THE GRAM-NEGATIVE BACILLI

The Gram-negative Bacilli may be divided into three main groups:

1. Those associated with enteric infections.
2. Those associated with the respiratory tract and nearby parts.
3. Those associated with general infection.

1. Gram-negative bacilli associated with enteric infections.

The organism associated with enteric infections are Salmonella typhosa and others of the Salmonella genus, Shigella dysenteriae and Bacterium coli.



WIDAL REACTION

1.a. *Salmonella typhi*: This organism, which is the cause of typhoid fever, was discovered by a German Physician, *Eberth*, in 1880. It is a non-spore-forming and actively motile gram-negative rod, which can be killed easily by heat and chemical disinfectants. It can live in water, milk and sewage for many days. The bacilli enter into the body through the mouth, with contaminated food, water or milk, and settle down usually in lymphoid tissues of the intestine. The bacilli multiply here and in about a week the organisms appear in the blood stream. During the second and third week they are found in the faeces and in many cases in the urine also. The type of antibodies formed in typhoid fever are called agglutinins which clump the bacteria. The test for agglutination reaction which is known as Widal Test may be done any time after the first week. The patient's serum is mixed with a drop of broth containing typhoid bacilli and is examined under the microscope. If the patient's serum contains antibodies, the bacilli are seen clumped together in about fifteen minutes. The same test may also be carried out by the macroscopic method. A positive reaction shows that the

person has antibodies, but they may be due to current typhoid fever, to a previous infection or to artificial immunization against typhoid by vaccine. If a second specimen taken a few days later is found to contain more antibodies the test has greater diagnostic significance.

1.b. *Salmonella group*: These are similar to the typhoid bacilli and may cause a milder type of fever known as paratyphoid fever, or a gastroenteritis. Active immunity against paratyphoid fever A and B and typhoid fever may be produced by T.A.B. vaccine, a suspension of killed bacilli of all types.

1.c. *Shigella dysenteriae*: There are different varieties of dysentary bacilli. The Shigella and Flexnari are two of the common ones. These organisms can live only for a short time outside the body and may be killed easily by heat and disinfectants. They cause ulcers in the large intestine and are found in the faeces. They do not usually enter the blood stream.

1.d. *Vibrio cholerae*: They are comma-shaped Gram-negative bacilli which produce cholera or acute gastroenteritis in man. The disease is endemic in many parts of India. This organism is curved or comma-shaped and is actively motile. It causes infection in the same way as typhoid bacilli by ingestion. Infection can be acquired through contaminated water or food. Organisms are present in large numbers in stools.

The stools consist mainly of water and a few suspended particles of the epithelial lining of the intestine. This gives the stool the typical 'rice water' appearance. Prophylactic vaccination against cholera is of value but the immunity lasts for about six months only.

1.e. *Escherichia coli*: Organisms of this species are found in the intestines of all animals and man and they are discharged in large numbers in the faecal matter. They are harmless in the intestine but may cause serious infection in the urinary tract, if they enter it. Some types of Escherichia coli are found to produce infantile diarrhoea in children below 2 years. These are known as enteropathoganic. E.Coli and it is important to remember that when sterilization procedure breaks down or is done improperly, it may lead to an epidemic of enteropathogenic E.coli diarrhoea in new born nursery.

If water is to be tested for contamination with faecal matter, it is tested for the presence of E.coli which is usually present in large numbers and can be discovered even in a small sample of water.

The nurse has a great part to play in the control of enteric infections. The faeces, urine and any linen contaminated with excretions should be disinfected. The patient's utensils should be boiled. The nurse should wear an apron while taking care of the patients and wash her hands well after caring for them in order to protect herself and other patients. The control of carriers, proper supervision of milk and water supply, and proper disposal of sewage are other factors important in protection of the community.

2. Gram-negative bacilli associated with respiratory infections

2.a. *Haemophilus influenza:* This bacillus is found in the nose and throat of many normal people and is transmitted by droplet infection. It is easily killed by heat and chemicals. Diseases caused by this organism are bronchopneumonia and other respiratory infections, conjunctivitis and occasionally meningitis and endocarditis.

2.b. *Bordetella pertussis:* This is the causative organism of whooping cough which is a serious disease in children because of resulting complications. This bacillus is killed easily. It is found in the sputum, saliva and nasal discharges of the affected person and is transmitted by droplet infection. Whooping cough vaccine which is made of killed whooping cough bacilli is effectively used to prevent the disease.

3. Gram-negative bacilli causing general infections

3.a. *The Genus Brucella*: There are a variety of organisms under this group and some affect animals like cows, pigs and goats. One of these species Brucella abortus, causes abortion in cattle. If milk from the infected animals is used, it may cause undulant fever in human beings. This fever is not highly contagious, but if the patient has any open lesions all dressing should be disinfected, since organisms present on them might be picked up and enter through abrasions on the nurses' hands thereby causing infection.

3.b. *Pasteurella pestis*: This organism is a short, thick, non-spore-forming rod which causes bubonic and pneumonic plague. The disease affects rat, ground squirrels and their parasitic fleas first. When these animals die, the fleas leave their bodies and may go to human beings. The clothing of the patient and any possible formites should be treated to kill the fleas. The patient must be isolated and nurses and physicians should wear gowns while taking care of the patient. Rats and fleas should be completely destroyed. Preventive vaccination is useful but the immunity lasts about six months only. The disease plague has been eradicated from most countries including India.

SPIROCHAETES

Spirochaetes are slender easily flexible spiral organisms. These are made up of tight coils or of loose irregular spirals of varying height. The important pathogenic organisms included in this group are:

1. Treponema pallidum causes syphilis by sexual contact.
2. Borrelia species causes relapsing fever and gets transmitted by ticks or lice.
3. Leptospira species causes Leptospirosis through the agency of several animals. E.g. rats.

Treponema pallidum, the important pathogen of the group die very quickly outside the body. High temperatures kill them in a few minutes. They are usually transferred from person to person by direct sexual contact. Transfer by kissing may cause a primary lesion on the lip. Syphilis may also be transferred through blood transfusion since the organisms are found in the blood of the diseased person. Since the Treponema die within 48 to 72 hrs outside the body, blood kept in the refrigerator for 3-4 days, are safe for transfusion.

Chlamydiae

These organisms require living cells for their growth and are filterable but they have both RNA and DNA and are susceptible to antibiotics and chemotherapeutic agents. They are therefore considered as bacteria adapted to obligate intracellular parasitism. The

size varies from 200 to 1000 nm.

Diseases caused by chlamydiae include:

1. *Trachoma*: This is caused by an organism called chlamydia trachomatis. It is a chronic inflammatory condition of the eyelids. It is one of the chief causes of blindness in India. It causes chronic conjunctivitis which may gradually affect the cornea and cause blindness. Transmission is by direct contact with infected persons or through formites.

2. *Psittacosis* is caused by Chlamydiae Psittaci. The organism is present in bird droppings and man gets infected through inhalation. The resulting disease is a type of pnuemonia.

3. *Lymphogranuloma Venereum*: This is a venereal disease common in tropics. The infection is spread through sexual intercourse. A painless lesion on the external genitalia soon spread to the lymph nodes which enlarge and suppurate. Elephentiasis of the vulva is a complication.

Mycoplasma

Mycoplasmas are bacteria that are cell wall deficient and are therefore of varying shapes and sizes. They are gram negative and are difficult to grow. They grow on media enriched with serum and yeast extract. Because of their plasticity they are filterable. Mycoplasmas are easily killed by temperatures above 56° C but can survive at 37° C. Mycoplasmas are the smallest free living micro organisms of size 125 to 1000 nm.

Diseases caused by Mycoplasmas included Primary atypical pneumonia caused by M. pneumoniae and genital infections caused by Mycoplasma horminis and Ureaplasma urealyticum. Mycoplasmas are sensitive to tetracycline and erythromycin.

Rickettsiae

Rickettsiae are Gram negative pleomorphic rods 0.3 – 0.6 x 0.89 – 2 μ in size. They are large enough to be seen under the microscope. They contain both DNA and RNA and divided by binary fission. Though they are unable to grow in cell free cultures like viruses they are sensitive to antibiotics. They are therefore true bacteria. Rickettsiae are susceptible to tetracycline and Chloramphenicol. Penicillin and sulphonamides are ineffective against rickettsiae.

Rickettsial diseases are transmitted to man by insects. Lice, fleas and ticks are all important vectors. The rickettsial disease most likely to be seen in India is the scrub typhus caused by Rickettsia Orientalis. Other diseases are Rocky mountain spotted fever, Trench fever and Q fever.

Actinomycetes

Actinomycetes are filamentous bacteria which resemble fungi. Actinomycetes are Gram positive, non-motile, non-sporing, non-capsulated filaments. There are three medically important types of Actinomycetes namely Nocardia, Actinomyces and streptomyces. Nocardia is aerobic while the other two are anaerobic. The streptomyces group are sources of antibiotics.

Diseases caused include:

1. *Actinomycosis*: caused by Actinomyces israelii. The organisms are part of normal flora of oropharynx and gastraintestinal tract. They produce lesions (abscess) when normal flora is traumatised. The lesion produced by these organisms show multiple openings through which pus comes out. The pus contains small granules and the organisms can be demonstrated in these granules of pus. Treatment with antibacterial drugs is effective.

2. *Nocardiosis* is caused by Nocardia. N. madurae is one of the causes of Madura foot. N asteroides may cause abscesses in lungs, brain, kidneys or intestines. Prolonged treatment with antibacterial drugs is needed.

CHAPTER 9

VIRUSES

Diseases caused by Viruses

Virus infection is one of the commonest causes of diseases in human beings. A very wide variety of diseases are caused by them. These diseases may be very mild and inconsequential, or of moderate severity or life-threatening. There have been some recent evidence that one or two particular types of malignancy are caused by virus infection. The following list of diseases caused by viruses is not a comprehensive one; it gives only the more common examples.

Diseases caused by Viruses Transmitted by Mosquitoes

Japanese B encephalites

Culex mosquitoes transmit JE virus. It infects animals, birds and man. Among many infected individuals only a few develop encephalitis. The remaining individuals develop immunity. From the clinical features of a patient one cannot distinguish between JE and other forms of encephalitis. The name Japanese came from the fact that this virus was first identified in Japan. JE virus vaccine has been developed by Japanese scientists.

Dengue fever (break-bone fever)

Aedes egypti mosquitoes transmit dengue virus, which causes a syndrome of high fever, severe body ache – particularly in the back, around the large joints and in the periorbital region and in some, a fine generalised erythematous skin rash. The rash may occur in the palms and it may be accompanied by itching.

Virus Diseases Transmitted by Droplet Infection

Common Cold (coryza)

Since there are many types of common cold viruses, an individual may get repeated attacks. A person with cold broadcasts viruses while

coughing or sneezing. Covering nose and mouth by a handkerchief reduces the chance of infecting others.

Sore throat, bronchitis, bronchiolitis, croup, pneumonia etc. are commonly caused by many viruses. They include adeno-viruses, para-influenza viruses, influenza viruses and respiratory syncytial virus.

Measles (Rubiola)

All children get measles virus infection and most of them develop clinical measles, characterised by fever, generalised maculopapular skin rash, cough, stuffy or runny nose, conjuctival redness and Koplik's spots. Measles vaccine is now widely used to prevent measles and its complications. A disease of older children and young adults, called subacute sclerosing panencephalitis is a late sequela of measles virus infection.

Rubella or German measles

This is another exanthematous fever, occasionally confused with measles. The illness is usually mild and often undiagnosed. The medical importance of this infection is due to the fact that rubella virus infection in a non-immune pregnant women can affect the normal development of the foetus.

Chickenpox (Varicella)

The varicella virus is transmitted by droplet infection. The resultant infection manifests as an illness characterised by a vesicular rash. After recovery, the virus may remain dormant (latent) in the body for many years and then cause another illness called herpes zoster. Children may acquire chickenpox after contact with a patient with herpes zoster.

Smallpox – Variola

This disease has been eradicated from the entire world by the systematic application of smallpox vaccination. Therefore vaccination against smallpox is no longer necessary.

It may be of interest to note here that many communities in India believe that smallpox and other exanthematous fevers are caused by the visitation of the goddess. This superstition is gradually declining.

Viruses Diseases Transmitted by Faecal-Oral Route

Poliomyelitis

Poliovirus types 1, 2 or 3 may cause this disease. While the vast majority of children get infected without ill effects, one in 100 to 300 children develop a neurological disease – either limp paralysis, bulbar paralysis or a combination. Disease is due to the infection and destruction of the motor nerve cells of the spinal cord or the cranial nerve nuclei. One of the predisposing factors causing an increased chance of paralysis is intramuscular injection during a subclinical infection. Such disease is called provocation poliomyelitis. Two kinds of vaccines are available to prevent poliomyelitis. They are inactivated or killed vaccine given by injection (Salk) and live attenuated vaccine given orally (Sabin)

Rotavirus diarrhoea

One of the commonest causes of gastroenteritis in infants and young children is a newly identified virus called rotavirus.

Virus hepatitis

Viral hepatitis refers to primary infection of the liver by one of the five viruses causing hepatitis namely Hepatitis type A, type B, type C, D and E. Type CDE are also called nontype A and nontype B. Clinical manifestations of all these types are similar but the methods of transmission are different. Hepatitis A and E are transmitted by Faecal-Oral route. Hepatitis B is transmitted through contaminated blood and blood products, unsterile syringes and needles, unsafe sex, perinatal, intimate physical contact between children or mother and child. Hepatitis C and D are transmitted through contaminated blood and unsterile syringes and needles. Hepatitis may result in chronic, liver disease.

People who are likely to get infected such as health care workers and those who have to receive repeated blood transfusions, must be protected by active imunization with vaccine. Three doses of vaccine are given. The first dose is followed by second a month later and the third six months after the first dose. Screening of donor blood and absolute sterility of syringes and needles are absolutely necessary to prevent iatrogenic transmission of HBV.

Other Important Diseases

Rabies

Rabies virus is transmitted from animals by bites. It infects the salivary glands and the brain; the brain disease makes the animal irritable and it bites indiscriminately and while it bites the virus in the saliva is inoculated into the wounds. Infected dogs are the commonest source of infection for humans. Rabies virus reaches the brain and causes an illness which is commonly called rabies or hydrophobia. The latter name denotes 'fear of water'. The patient gets pharyngeal spasms upon drinking. These spasms are very painful. As the disease progresses the very sight of water causes spasm.

Human saliva is often free of rabies virus and human-to-human transmission is extremely rare. However persons at increased risk of infection like veterinarians and medical and nursing personnel may take prophylactic (pre-exposure) immunisation. Pet dogs, cats, cattle etc. should also be protected by immunisation. Unimmunized persons and animals exposed to rabies virus infection should be given post-exposure immunisation. Conventional sheep brain vaccine and modern cell culture vaccine are available in India.

Herpes Virus Infection

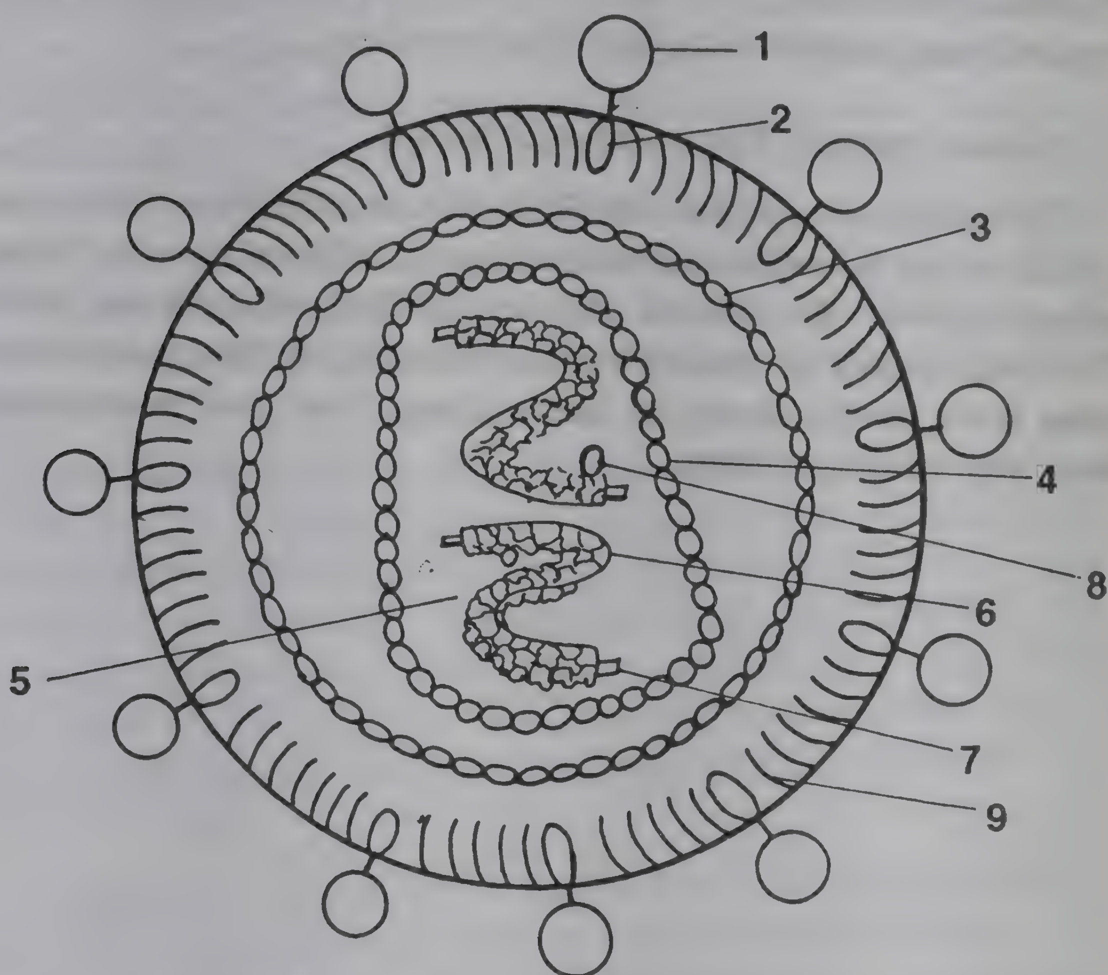
Herpes simplex type 1 virus may cause gingivostomatitis in children. Herpes simplex type 2 virus causes genital herpes which is sexually transmitted. Both types may become dormant (latent) in the body and cause recurrent vesicular eruptions at the lips (tuype 1) or genitalia (type 2). These agents can occasionally cause corneal ulcers or encephalitis.

Human Immunodeficiency Virus

Human Immunodeficiency Virus (HIV) is an RNA Virus causing Acquired Immunodeficiency Syndrome (AIDS); It is a retrovirus where genetic information is passed from RNA to DNA with the enzyme reverse transcriptase, which is in the structure of the virus.

The HIV has now been found to be having two serotypes which are HIV – 1 and HIV – 2. Once a person gets infected with HIV the virus gets integrated into the host chromosome and the infection persists thus making the person at risk for the development of virus associated

disease throughout life. The invasion of CD4 (T4) cells cause immunodeficiency which allow the body to be attacked by opportunitic diseases like candidiasis, pneumocystis carini pneumonia and Kaposi's Sarcoma.



Structure of HIV (a diagramatic representation)

1. Knob of protein gp 120 (glycoprotein)
2. Spike antigen gp 41
3. Viral protein P IT/18
4. P 25/25 core protein
5. Virus Core
6. P9/P7
7. RNA
8. Reverse transriptase
9. Lipid bilyer

HIV is primarily a sexually transmitted infection. The second method of transmission is through blood products. Contaminated needles can transmit the infection among drug addicts. Needlestick injury is a source of infection among healthcare workers. There is no preventiva vaccine or curative treatment available. Prophylaxis depends on health education, elimination of high risk activities and adequate precautionary measures by health care workers.

Viruses causing Haemorrhagic fevers

The causative organisms are Ebola Viruses which are RNA viruses. Rodents act as reservoirs and transmission is believed to occur through rodent excreta. The natural reservoir of Ebola virus is not known. The fevers caused by various viruses belonging to this group include Lassa fever, South American haemorrhagic fever and Haemorrhagic fever with renal syndrome.

CHAPTER 10

DISEASES CAUSED BY FUNGI (MYCOLOGY)

Fungi are plants. They are of medical importance for two reasons. They cause some diseases and they are the source of some antibiotics. The two important forms of fungi are moulds and yeasts. Yeasts are unicellular fungi. Some yeasts multiply, like bacteria, by fission. Other yeasts multiply by a process called budding. A protrusion of cytoplasm begins to form on one side of the cell. One part of the divided nucleus takes its place in the protruded part or bud. It continues to grow until the cell is fully developed and separates from the parent cell.

The moulds contain many cells. They form into threads and develop thick networks. A network of mould cells is known as a mycelium. The individual threads are called hyphae. Moulds reproduce by means of structures called spores. Certain mycelium are present for the purpose of reproduction. Their hyphae contains spores arranged in varied patterns. Some appear very beautiful under the microscope. The spores usually separate from the hyphae before forming a new growth of mould.

Fungi grow best in a moist atmosphere at a temperature slightly below body temperature. Low temperatures inhibit the growth of fungi but do not kill them. However, fungi are easily killed by high temperatures. They are able to grow in the presence of a higher concentration of acid and sugar than bacteria. All fungi must have oxygen to grow and can grow in light as well as in darkness.

Diseases caused by Fungi

Fungi are responsible for a number of infections in man and like bacteria can affect any part of the body or any tissue. Diseases caused by fungi usually are common in patients who are treated with long-term antibiotics, which destroy or inhibit the normal bacterial flora. Fungi which are not affected normally by anti-bacterial drugs multiply

and produce disease in patients, who are on drugs which suppress the body's defense mechanism e.g. Immunosuppressants, especially after transplantation surgery . Also, fungi can take an upperhand and produce disease.

Infection caused by fungus is called mycosis. When structures like hair, nails and skin are affected it is called dermatomycosis. Those lesions in the skin have a peculiar ring-like, scaly, appearance. They are called taenia or ring-worm disease. An infection that frequently occurs in the mouth of new born babies caused by a fungus is known as thrush. A fungus infection may sometimes affect the lungs or some other internal portion of the body. Some fungus infections respond quickly to treatment, others are very difficult to treat and are sometimes never cured.

Candidiasis is a disease caused by an yeast-like organism called candida albicans. Infection by these organisms can occur on skin and mucous membrane. It frequently occurs in the mouth, then it is called thrush. It can affect the lungs or some other internal portion of the body, like respiratory system.

Aspergillosis is caused by a mould aspergillus which is found abundantly in nature but under some circumstances can be harmful to man in causing disease. This fungus can also affect any organ in the body in immunosuppressed, debilitated patients.

Mycetoma or *maduramycosis* (madura foot) is a tumoriform infection usually of the foot and leg caused by filamentous bacteria (eg. Actinomycetes) and some filamentous fungi. The term eumycotic mycetoma designates tumours caused by true fungi, as opposed to those caused by actinomycetes. The mycetoma is called madura foot because it was first reported from Madurai.

Cryptococcosis is caused by yeast cryptococcus neoformans. These cause infection of the lung and meninges. Bird droppings may be a source of the organism. In patients who are on drug which suppress the immune responses after transplantation surgery, the disease occurs as a complication. It is also common in patients with AIDS. Infection by these organisms may be the cause of death in such patients.

Infections caused by true fungi like cryptococcus are important

because they cannot be treated so easily as bacterial or actinomycotic infections. In some cases of fungal infections, the treatment would be to remove the portion which is diseased.

CHAPTER 11

PARASITOLOGY

A parasite is an organism which is dependent on other organisms for its survival. It obtains nourishment and shelter from the organisms on which it thrives.

Parasites may be protozoa (single celled animals which perform all the necessary functions of metabolism and reproduction) and helminths which are multicellular worms.

Protozoa

1. *Entamoeba histolitica*

The amoeba is about 18-40 μ in size. This parasite passes its life cycle in one host only ie. Man. Amoeba move about with the help of pseudopodia. It forms cysts which are discharged in the faeces. They gain entry into a host through untreated water, raw vegetables or when food contaminated by carriers is consumed by man. They form trophozoites in the intestine causing destruction and necrosis in the tissues resulting in acute amoebic dysentery.

2. *Giardia lamblia*

This inhabits the duodenum and upper part of the jejunum. It exists in two forms -- trophozoites and cysts. The trophozoite is 10 to 20 μ in length and possesses flagella. When conditions become unfavourable encystment occurs. Man gets infected by ingestion of the cyst. Chronic enteritis, fever and other allergic manifestations may occur.

3. *Trichomonas*

These are flagellated and have only trophozoite state and no cysts. Trichomonas vaginalis cause infection in female genital tract and urinary tract of males and females 10 to 30 μ in length.

4. *Leishmania*

These are flagellated organisms. Leishmania donovani cause

infection in the reticuloedothelial system causing Kala azar. Leishmania tropica causes oriental or tropical sore. Sandflies are the transmitting agents.

5. *Trypanosoma gambiense* causing sleeping sickness is prevalent in Africa. The transmitting agent is Tse-Tse flies.

6. *Plasmodium.*

The parasite belonging to this genus has two cycles of growth, the asexual cycle in man and the sexual cycle in mosquito ie. Man is the intermediate host and mosquito is the definitive host.

Eg. Malaria, filaria

7. *Toxoplasma gondii*

The parasite is a small protozoon. Domestic cat is the definitive host and mouse, man and other animals are intermediate hosts. Transmission may be by

1. ingestion of undercooked meat, cows milk and eggs
2. the faecal-oral route
3. inhalation of droplets
4. contact with the infected tissues of animals.

The organism spread to almost all tissues of the body and signs and symptoms of the disease depends on the site or organ affected.

Three protozoal parasites cause fatal opportunistic infections in man with immune defeiciecy especially with Acquired Immuno-Deficiency Syndrome. They are Isospora belli and cryptosporidium causing diarrhoea and Pneumocystis carinii causing lung infection.

Helminths

Helminthic (worms) parasites which are multicellular organisms are macroscopic. Their presence in the body is diagnosed by microscopical examination of faeces for the presence of ova or cyst. The embryos of Wuchererial bancrofti (microfilaria) which cause filaria are found in peripheral blood taken at night.

APPENDIX

SUGGESTIONS TO INSTRUCTORS FOR SIMPLE LABORATORY PROCEDURES

The following exercises are designed to serve as a guide to the instructor.

Exercise No.1

Introduction on the use of a microscope

1. Locate the different parts of the microscope[1] (compare with the sketched model).

2. Explain the power of magnification by use of various objectives.

3. Have student observe thumb prints, onion cells, cotton fibres, lice, hair, with low and high power settings.

Also examine slides of frog's blood prepared and stained previously.

(Instructions: *Keep both eyes open while looking through the microscope. Never focus down on a slide with the eye at the ocular. Always watch the lowest point of the objective when lowering the tube.)*

Demonstrate staining

Simple stain

Gram Stain

(Ref.Chapter 4) (Part V)

Show the equipment used in bacteriology laboratory

Agar Plates

Agar Slant

Various culture media

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[1] Although most of the exercises are meant to be demonstrations and it may not be required that the student practice focussing with different objectives, it is desirable that the student learns the use of the "fine adjustment'. Measures to prevent damage to the lens should be pointed out also.

Exercise No.2

Demonstration of Characteristics of Bacteria

A. Distribution of bacteria

1. Students may work in groups. Each group is furnished with 8 agar plates. (Petri dishes with agar-agar)[1].

One petri dish is exposed to the laboratory air for 10 minutes; another for the same length of time, just after the laboratory has been swept; another in a ward for 10 minutes while the beds are being made. Exposure is made by removing the lid from the dish.

2. Remove the lid of petri dish No.4. Press your finger tips to the surface of the medium.

3. Rub a sterile swab over a student's teeth and gums and then rub this over the medium in petri dish No.5.

4. Have a student speak into petri dish No.6 and cough into plate No.7.

5. Have petri dish No.8 as a sterile control.

Incubate all plates at 37o C for 24-48 hours.[2]

Have the students write the following:

(a) Report number of colonies present.

(b) Report evident number of kinds present.

(c) Does plate 1 or 2 have more colonies ?

(d) What does this indicate ? How does the number of colonies in plate 3 compare with that of 1 and 2?

(e) Are all colonies alike or do they differ in characteristics such as size, shape and colour? What does this include ?

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[1] See page 272, for instructions for making culture media.

[2] Where an incubator is not available, very successful cultures may be grown in dark cupboards during warm weather when room temperature may be near that produced in incubators. All petri dishes are sterilized before any experiment.

B. Shape and arrangement of bacteria

Students should examine and make drawings of slides, showing the arrangement of the following micro-organisms:

Staphylococci	Bacilli
Streptococci	Spirilla
Diplococci	Spirochetes

C. Students should examine prepared slides of micro-organisms showing the following structures: spores, capsules, flagella.

D. Motility of micro-organisms could be observed by students in hanging drop preparations demonstrated by the instructor.

Exercise No.3

Conditions Affecting Growth of Microorgansims

A. The effect of nutrients on bacterial growth

From a culture of pus, inoculate one tube of each of the following slants:

(a) 1.5 per cent agar in water.

(b) 1.5 per cent agar plus 0.5 per cent peptone in water.

(c) 1.5 per cent agar plus 0.3 per cent beef extract in water. Incubate for 48 hours. Record results.

B. Effect of acidity and alkalinity

From a culture of an organism inoculate several tubes of broth, each of whichhas been adjusted to the following pH value: (Prepared by the bacteriologist) pH 3.0, pH 6.0, pH 7.0, pH 7.5, pH8.0, pH11.0. Which are the tubes that show maximum growth ?

In which do you find the least growth ?

What is this due to ?

C. Effects of sunlight on bacterial growth

Inoculate one tube of melted agar with one loop of a diluted broth culture of E.Coli or other organsim. Shake and mix thoroughly to get a uniform distribution of E.Coli. Pour the agar into a petri dish and allow to harden. Expose half of the petri dish to direct sunlight for 3 hours while the other half is protected with a piece of black paper. Incubate for 48 hours.

On which half of the plate are there more colonies ?

What does this indicate ?

Exercise No.4

Removal of Microorganisms

A. Effects of Handwashing

Have a studentlightly touch her finger over the medium in plate No.1. Let the same student wash her hands with soap and water using some friction. Dry hands and gently press the fingers over themedium in plate No.2. Incubate for 24 hours.

On which plate are there more colonies ?

What does this indicate ?

B. Effects of chemical disinfection

Allow a clinical thermometer to be held in a student's mouth for one full minute. Inoculate a petri dish by rubbing the thermometer gently over the medium. Wipe the thermometer. Allow to stand in 5 per cent carbolic for five minutes. Inoculate petri dish No.2. Repeat experiment allowing thermometer to stand in 5 per cent carbolic for 10 minutes.

In which plate do you find colonies ? Which is the one that has the least number of colonies ?

(This experiment may be repeated with different strengths of solutions and different intervals).

C. Effect of boiling and pasteurization

By means of a sterile pipette, place 1 c.c. of tap water in petri dish No.1.

In petri dish No.2 place 1 c.c. of water that has been boiled for 20 minutes and cooled.

Place 1 c.c. of raw milk in petri dish No.3.

In petri dish No.4 place 1 c.c. of milk that has been pasteurized. (Heating to 65oC and then cooled immediately to 10oC).

Pour a tube of melted agar into each of these plates. Rotate the dishes gently until the material has been mixed thoroughly. Allow the medium to solidify. Incubate for 48 hours.

Record the number of colonies in each plate. What does this indicate ?

D. Action of antibiotics

Inoculate one tube of melted agar with one loop of a diluted broth culture of S.Aureus. Shake and mix thoroughly. Pour the agar into a petri dish. Allow to harden.

When the inoculated agar plate is solid, place in the centre a small square of filter-paper which has been dipped into penicillin. Incubate at 37°C. Note the presence or absence of growth around the filter-paper.

E. A visit to the sterilizing room of the hospital to demonstrate autoclaving.

Instructions For Making Culture Media

Nutrient agar

Peptone 10 gm.

Sod. Chloride 5 gm.

[1]Beef extract 3 gm.

Agar agar 1.5 gm.

Distilled water 1,000 ml.

Mix the ingredients in distilled water. Bring to a boil and continue to heat in a water bath until the agar is dissolved. Adjust the pH to

7.5-7.6 or test with litmus paper. If the reaction is acid add sodium bicarbonate or sodium hydroxide until it is neutral. Filter the mixture through cotton. Divide into test-tubes filling about 1/4-1/3 full. Keep any extra amount in a large covered jar which can be sterilized. Sterilize in an autoclave for 30 minutes at 15 pounds pressure. This may be used for slant cultures. To prepare slants, allow the test-tube with agar to cool and solidify in a slanting position.

Agar plates

Melt a tube of nutrient agar in a water bath. Cool to 45oC-59oC. Remove cotton plug from the test-tube, flame the mouth of the tube and pour agar into sterile petri-dish. Raise the top of the petri dish only as far as necessary to pour conveniently. Rotate the dish gently until the agar spreads evenly over the bottom of the dish. Allow the medium to solidify.

Nutrient broth

Beef extract 3 gm. (or beef broth prepared for nutrient agar)

Peptone 10 gm.

Sod.Chloride 5 gm.

Distilled Water 1,000 c.c. (or beef broth, 1,000 c.c.).

Prepare as for nutrient agar, omitting the agar; or some of the broth may be kept separately, adding a proportionate amount of agar to the remainder. This amount will probably be sufficient for most schools for one class. If half the broth is used as liquid media, then add half the amount of agar to the remaining broth. Broth must have pH adjusted and be filtered as agar is. Sterilize in test-tubes in the same way, filling the tubes only 1/3 full.

Note [1] As a substitute for beef extract, beef broth may be made by soaking 1 pound of ground beef in the 1000 c.c. of cold water overnight. In the morning strain and press out all of the juice. Add enough water to make it up to 1000 c.c. Use for making agar instead of the beef extract 'and distilled water in the recipe. (Note over).

Blood agar

Ingredients

Sterile defibrinated sheep blood ... 7 ml.

Nutrient Agar (melted) ... 100 ml.

Preparation

Pour about 7 ml of melted Nutrient Agar, as a base, into sterile Petri dishes and allow to set. This forms a thin base for puring in the blood agar. Add sterile defibrinated sheep blood to Nutrient Agar, the latter should be cooled to about 45oC-50oC before blood is added. Mix well and pour about 15ml of blood agar over the base in each petri dish.

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GLOSSARY

The following list of words is taken from the text. Some are ordinary English words with their definitions; others are technical words with an explanation of their meaning and use. This glossary is meant to be a help to students in studying and understanding the text as it is written and as a means of revision of important terms they should know and understand.

A

Abortion—birth of a baby too soon, before it is fully developed.

Abrasion—a scratch or slight scraping away or break of the skin.

Accessory—additional or helping.

Accomplishment—what one is able to do, skill, qualification.

Acetone bodies—substance produced when fats are not properly oxidized because of inability to oxidize glucose in the blood.

Achieve—carry out, accomplish, bring to successful end.

Acne—a skin condition, inflammation of the sebaceous glands.

Acquire—to gain, get, obtain.

Acquired immunity—one which is not inborn but which one develops either naturally or artificially.

Active immunity—an immunity developed by the work of the body itself.

Adequate—enough to meet the need.

Administer—to manage, to give or apply medicines.

Administrative—managing.

Adolescent—young person in the process or age of maturing, age about 12-20 years.

Aerobes—organisms which grow in the presence of oxygen.

Affiliate—to adopt, or join, to be closely associated.

Afford—to be able to bear the expense.

Agar (agar-agar)—substance like gelatin which is used for making solid culture media.

Agar plate—a petri dish of solid agar media for growing bacteria.

Agglutinins—antibodies which cause bacteria to stick together in clamps.

Allergy—individual hypresensitivity to a certain substance.

Alter—change.

Altruism—thoughtful interest in others.

Anaemic—having anaemia, i.e., lacking enough blood or more particularly lacking haemoglobin or red blood cells.

Anaerobes—organisms which cannot grow in the presence of free oxygen.

Anaphylactic shock—severe reaction to the foreign protein of serum, with symptoms of edema and itching about the site of injection, edema of face, hands and other parts of the body, dyspnoea, cyanosis, dilatation of pupils, collapse.

Animism—religion involving worship of nature.

Antibiotics—drugs obtained from one group of micro-organisms which can inhibit other micro-organisms.

Antibodies—substances produced in the body to fight against bacteria and their toxins.

Antigen—any substance which stimulates the body to produce antibodies.

Antimicrobial antibodies—antibodies which act on the micro-organisms themselves.

Antiseptic—a substance that prevents the growth and multiplication of micro-organisms but does not necessarily kill them.

Anti-toxins—antibodies which neutralize bacterial toxins.

Apparatus—set of tools, equipment for a specific task.

Apparent—seen noticeable.

Apparently—seemingly.

Appendage—a part attached to a body much like an arm is attached to the human body.

Appropriate—fitting.

Approximate—as nearly accurate or correct as possible.

Aqueduct—channel or large pipe for passage of water.

Archaeologist—one who studies about ancient times.

Architecture—art of building.

Aristocracy—people of high rank, noblemen.

Artificial—not natural, produced by human skill.

Asepsis—absence of infection or of pathogenic organisms.

Associated—related, connected, having the same governing body.

Atherosclerosis—a form of arteriosclerosis or loss of elasticity with hardening of the arteries.

Authority—power to command or to act for another, people who have such power.

Autoclave—apparatus for sterilizing with steam under pressure.

Autopsy—examination of a dead body to find the cause of death.

Auxiliary—helping or related.

Available—obtainable, can be got.

B

Bacteria—microscopic single-celled organisms usually classified as plants but which contain no chlorophyll.

Bacteriocide—a substance which can kill micro-organisms.

Bacteriolysins—antibodies which dissolve bacterial cells.

Bacteriostasis—a condition in which bacterial growth is checked without necessarily killing the organisms.

Bake—to cook food with hot air all around it; a method of sterilization by hot air at a temperature of 170°C for 2 to 2½ hours.

Balanced diet—a diet which contains all the essential nutrients in the right amounts and correct proportions.

Barbarian—foreigner, uncivilized person.

Barrier—something which prevents progress or attack.

Basal metabolic rate—amount of energy required by a person who is awake but is as nearly as possible at complete mental and physical rest and has had no food for 12-14 hours.

B.C.G. Vaccine—a vaccine used to produce artificial immunity to tuberculosis.

Bilirubin—colouring material, pigments of the bile.

Bland diet—a diet of soft and easily digestible foods which are not irritating.

Boil—to cook water at 100°C.

Bovine—of cows or cattle.

Broad spectrun antibiotic—one which is effective against many kinds of micro-organisms.

Bronchopneumonia—inflammation of the lungs which develops along the bronchi.

Bulk—size or volume.

C

Calcification—becoming hardened by the addition of calcium.

Calculation—figuring out.

Calorie—amount of heat required to raise the temperature of 1 kg. of water (1000 gm.) through 1° Centigrade.

Capsule—a covering of some bacteria, like an envelop of gelatin; a means of protection of the organism.

Carbohydrate—a simple or compound sugar.

Carbuncle—a large infection made up of several boils.

Career—occupation or calling.

Carrier—a person who has pathogenic organisms in his body and though not being sick himself may spread the disease to others.

Catabolism—destructive metabolism.

Catalyst—a substance which stimulates chemical reaction between 2 other substances without itself entering into the reaction; a helping chemical.

Caustic—capable of burning organic tissue.

Cereals—grains.

Characteristic—special mark, quality or nature.

Chastity—sexual purity.

Cheilosis—cracking of the lips caused especially by Vitamin B deficiency.

Chivalry—the training of the knight which stressed service to others and protection of the weak.

Chronic carriers—persons who have had no visible signs of disease but whose body still contains and spreads pathogenic organisms.

Citrous—fruit of one particular kind such as lime, lemon, orange, sweet lime.

Civil—referring to affairs of government in a nation.

Civilian—not military i.e., not relating to army or navy.

Classic—literature or art of the highest kind.

Classify—to group according to kinds.

Clergy—ordained ministers.

Coagulate—to clot, thicken.

Coagulation—clotting, forming curds, the process of liquids becoming thick.

Collapse—a falling in or shrinking together, a condition of sudden failure of vital powers, extreme shock.

Combat—fight against.

Combination—joining or union.

Compact—pressed together to make small in size.

Complete proteins—those which contain all the essential amino acids.

Complex—made of several or more parts.

Complicated—having many confusing parts, confusing.

Complication—a secondary condition which occurs during a disease, which usually affects some other part of the body than the one affected in the first place.

Composition—union of different elements, the way different parts make up the whole.

Compound—a substance formed by the union of 2 or more substances.

Compress—press together into smaller space.

Concentrate—to increase in strength by removing liquid or unnecessary substance.

Concentrates—medicines strengthened by removing water or other unnecessary substance.

Concentration—the strength of a solution: act of increasing the strength by evaporating liquid.

Condiments—spices.

Conduction—passage of heat through matter or substance.

Conjunctivitis—inflammation of conjunctiva or lining of the eye.

Consist—to be made of.

Constituent—important part of the whole, element.

Construct—to make or build.

Consult—to ask advice.

Contaminate—to make dirty or infectious by contact.

Content—what something contains or holds.

Contract—to draw together, to get (as a disease).

Contribute—give.

Convalescence—the period of gradually returning health and strength after acute symptoms of disease have disappeared.

Convalescent—one who is recovering health after disease.

Convalescent carrier—one who still has organisms in his body during the stage of convalescence and may therefore pass them to others.

Convalescent serum—serum taken from the blood of a patient convalescing from a disease. This serum will contain antibodies.

Convert—change.

Coordinate—to bring parts together in harmony.

Corrode—to eat away by chemical action, to cause rusting.

Cross-infection—passing infection from one patient to another so that a patient whoi s admitted for one disease condition develops a second infection while in hospital.

Crusades—religious pilgrimages to Jerusalem to rescue Christ's tomb from the Moslems.

Crystalline—made of crystals or clear, transparent, particles.

Culture—a growth of micro-organisms, to grow micro-organisms.

Culture media—food material on which bacteria are grown in this laboratory.

Curricula—courses of study.

D

Deaconess—a woman leader in church work, specially appointed for this work.

Deamination (Deaminization)—separation of the amino group from amino acids with the formation of ammonia.

Decline—going down.

Decompose—to break down into elements, to decay.

Defective—incomplete or faulty, deficient, abnormal.

Defence—protection, guard, power or skill to resist attack.

Defibrinated—with the fibrin removed.

Deficiency—not enough in amount, lack.

Dehydration—dired out from lack of water, therefore a condition of the body when water is not sufficient for normal needs.

Delay—to slow.

Democratic—believing in social equality and government by the people as distinguished from aristocratic which refers to maintaining class differences and government by those of the highest class.

Deodorize—to remove odour or smell.

Deposit, deposition—collection and laying down of a substance in some part of the body.

Depress—to lower or lessen.

Derive—to get from a source, to come from originally.

Detergent—a cleansing agent similar to soap.

Deteriorate—to reduce or become less in value.

Determine—to decide, to reach a solution.

Diagnosis—to discover what a patient's disease is by observing symptoms and by tests.

Diagnostic—for diagnosis.

Dice—to cut into small cubes.

Dietetics—application of principles of nutrition to the human body in health and disease.

Differential stain—one which shows up differences between organisms so as to be able to separate one from another.

Differentiate—to separate kinds according to differences.

Diffuse—to pass through and spread.

Dilatation—widening, enlarging.

Dilute—to weaken the strength by mixing with water.

Dilution—a fluid weakened by mixing with water.

Disaccharide—a sugar composed of 2 units of simple sugar.

Disband—dismiss from service, break up.

Disinfectant—a substance which kills pathogenic organisms—usually used regarding chemicals.

Disposable—easily got rid of that which can be thrown away and need not be kept.

Dispose of—get rid of, throw away.

Disposition—natural character to temper, habit of the mind.

Dissect—to cut into small parts in order to examine carefully.

Distribution—division or scattering.

Diuresis—increased secretion of urine.

Droplet-infection—infection spread by fine droplets of saliva and mucus which may be sprayed into the air when coughing or sneezing.

Droplet nuclei—the very small amount of substance remaining after evaporation of droplets.

Dungeon—dark, underground prison.

E

Eczema—a kind of inflammatory skin disease.

Edible—that which can be eaten.

Effective—having the power to produce results.

Elaborate—complicated, not simple.

Elevate—to raise.

Eliminate—to remove.

Emaciation—extreme loss of weight and loss of flesh.

Emancipation—liberation or setting free.

Embryo—earliest stages of development of unborn young of a species.

Emetic—drug given for the purpose of causing vomiting, as after the swallowing of a poison.

Emulsify—to make into a liquid mixture in which fat is broken up into tiny drops hanging in the liquid.

Endocarditis—inflammation of inner lining of the heart.

Endo-toxin—toxin which remains within the cell membrane of the organism until it dies and the cell breaks up.

Endowed trust—money given permanently for a particular cause and controlled by a governing board. The original money is kept at interest and only the interest is used for the specified purpose.

Energy—power to do work.

Enforce—to carry out, to make effective.

Enteric—referring to the intestines, of the intestines.

Enzyme—chemical substances which can help to cause chemical changes.

Eruption—breaking or coming through : of teeth, coming through the gum.

Essential—necessary.

Estimate—to work out approximately, or fairly accurately.

Eventually—in time, finally.

Evidence—proof.

Excavate—to dig up.

Excessive—too much.

Exclude—to take out, reject.

Exclusive—restricted, allowing only selected ones.

Excrete—to discharge or throw off from the body as waste.

Excretion—waste products which are thrown off from the body such as urine and faeces.

Exotoxin—toxin which passes through the cell membrane into surrounding body tissues.

Expectation of life—or life expectancy—length of time we can expect to live.

Expend—to use up.

Expenditure—using up.

Expose—to leave unprotected, be uncovered.

Extraordinary—unusual, remarkable, beyond the usual way.

Extrinsic—from outside (the body).

F

Facility—ease, a thing which makes it easy to do something.

Factor—a circumstance or element which produces a result.

Fatal—causing death.

Fatalistic—having the belief that what happens is an action of fate which cannot be prevented or is one's bad luck over which he has no control.

Fermentation—action of bacteria to break down carbohydrate.

Feudalism—a landlord system of owning land with serfs doing the work in return for food, shelter and protection.

Filter—a prous material such as sand, special clay, pottery, used to remove solid particles, dirt and bacteria; to pass a liquid through such a filter for purposes of purification.

Filthy—very dirty.

Filtration—process of passing a liquid through a fine porous material to remove bacteria.

Fix (a smear)—to flame a smear and thus kill bacteria make them stick to the slide.

Flaming—a method of sterilization by passing an article through an open flame.

Flatulence—presence of gas in stomach or intestines.

Flavour—taste.

Fluorescence—ability to give off coloured light.

Foe—enemy.

Fomite—articles which are contaminated with infectious discharges and which therefore indirectly carry infection from one person to another.

Food—any substance which can be used by body for growth, development or repair.

Forerunner—one who goes before and prepares the way.

Fortify—to strengthen, make richer and stronger.

Foundation—basis or lowest part—a money gift to support an institution or work.

Friction—rubbing.

Fry—to cook food in very hot fat or oil.

Function—activity or work.

Functional disease—one in which the activity or functioning of an organ may be disturbed and abnormal although there is no apparent injury to the organ itself.

Fungi—a kind of microscopic plant with no green colouring matter.

G

Gangrene—death of a large amount of soft tissue.

Gas gangrene—a wound infection caused by the gas bacillus which results in the formation of large amounts of gas in the dead tissues.

Germination—beginning of growth as in a seed.

Glossitis—inflammation of the tongue.

Glucosuria—excretion of sugar (glucose) in the urine.

Goitre—enlargement of the thyroid gland.

Gonorrhoea—an infection of the urethra and reproductive organs caused by the gonococcus. A venereal disease.

Governess—a woman who cares for or teaches children in their homes.

Gram's stain—a differential stain which divides bacteria into 2 groups.

Grill—to cook food directly over great heat or fire or on a grill plate over the fire.

H

Habit—special dress worn by member of a religious order.

Haemorrhage—bleeding.

Harbour—to keep sheltered or protected.

Haven—refuge, shelter.

Hematuria—blood in e urine.

Hinder—to prevent, to check.

Hormone—secretion of ductless glands.

Hospice—place of shelter for travellers.

Humanitarian—a person interested in doing charitable deeds for the sake of others.

Host—a living being which gives nourishment to a parasite or on which a parasite depends for life.

Hyperglycaemia—increased sugar (glucose) in the blood.

Hypochlorhydria—decreased secretion of hydrochloric acid

I

Identify—to recognize, to find, name, and classify, to prove the nature of.

Immunity—resistance to infection by a particular organism.

Immunization—a method of producing immunity, usually by the injection of vaccines or sera.

Inactivate—to make less active or make powerless to act or move.

Incidence—occurrence of disease.

Incineration—act of burning by fire to ashes.

Incomplete proteins—proteins which are lacking in some of the essential amino acids.

Incubate—to keep (bacteria) under favourable conditions for growth.

Incubator—a box-like container for culture which can be heated to maintain a regular temperature as required.

Indicate—to show.

Individual immunity—natural immunity of an individual to certain diseases.

Infection—condition caused by pathogenic organisms.

Interior—lower in place, rank or value.

Ingest—to put or receive in the stomach, to eat.

Inhibit—to check or slow.

Inhibition—checking (especially, of bacteria, checking their growth without necessarily killing them).

Inoculation—injection of micro-organisms or their toxins in order to stimulate the production of immunity.

Inorganic—chemistry which deals with substances which do not contain carbon as are found outside living things.

Insoluble—not soluble.

Insufficient—not enough.

Insulate—to cover with something to prevent heat loss.

Integrate—to bring parts together in one whole.

Intellectual—mental, having powers of understanding.

Intermittent sterilization—sterilizing on 3 successive days for 30 minutes each day for killing spore-forming organisms.

Intolerance—lack of ability to take without harmful effects.

Intradermal—within the skin, between the layers of the skin.

Intrinsic—being inside (the body).

Inunction—giving medicine by rubbing on the skin for absorption through the skin.

Invade—to enter a country with an enemy army, to attack an enemy.

Invalid—a person who is not well or healthy.

Investigation—testing, examination.

Ion—very small particle.

Irradiation—application of the sun's rays, ultraviolet rays, X-rays or other radiation to a patient or to a substance for therapeutic effect, e.g., action of sunlight on the skin to form Vitamin D.

K

Ketosis—collection in the body of ketone bodies from the incomplete oxidation of fatty acids.

L

Lactation—period when a mother is giving her own milk to her baby.

Lesion—a local spot of change in tissues, an injury, a wound or an infected spot in a skin disease.

Leukocytosis—increase in the number of white blood cells.

Liable—exposed to, subject to, likely to.

Litre—1000 c.c.

Lobar pneumonia—inflammation of the lungs which affects a whole lobe.

Lubrication—oiling.

M

Macroscopic—seen with the naked eye without a microscope.

Magnification—enlargement many times with the aid of a microscope.

Maintain—to keep running or prevent from stopping.

Malabsorption—poor absorption.

Mammals—animals (including man) which feed their young on the mother's milk.

Mantoux—a skin test to show an allergic reaction to the tubercle bacilli and therefore to show whether there is some immunity to it or not

Marked—noticeable, important or great.

Matrix—intercellular substance of a tissue.

Mature—fully grown and developed.

Mechanically—done by the use of force or motion.

Medium—a substance for the cultivation or growing of micro-organisms.

Melting point—degree of heat necessary to cause a substance to melt or liquefy.

Menial—referring to servants or work of the lowest kind.

Meningitis—inflammation of the meninges (membranes of spinal cord or brain).

Metabolism—changes which take place in nutrients from the time of their absorption until they reach the end products of the various processes through which they pass.

Methionine—an essential amino-acid containing sulphur.

Micron—a unit of measurement for micro-organisms equal to 1/25,000 inch.

Micro-organisms—living organisms which are so small they can be seen only with the aid of a microscope.

Military—referring to soldiers and warfare.

Ministration—service.

Modification—slight change.

Molds—multicellular plants which form a network of threads.

Monastery—home for people who have taken religious vows.

Monasticism—life, rules, conditions of monasteries where priests or nuns live

Monosaccharide—simple sugar.

Motile—having movement.

Motility—movement.

N

Natural immunity—immunity which a person has at birth or which he develops naturally.

Neuritis—inflammation of nerves.

Non-pathogenic—not producing disease or harmless.

Nutrient—a substance or material present in food.

Nutrition—all the processes or activities by which the human body receives and uses all the food necessary for its growth, development and repair.

O

Obesity—condition of being very fat or overweight.

Objective—end or goal of action or feeling, the lens of a microscope which is closest to the object. As an adjective refers to symptoms which can be observed by others than the patient.

Obstetrical—maternity, referring to child birth.

Occasional—happening now and then but not often

Oedema—swelling due to fluid in the tissues.

Oliguria—scanty secretion of urine.

Opsonins—antibodies which help and increase phagocytosis.

Ophthalmia neonatorum—a gonococcal infection of a newborn baby's eyes contracted during the process of birth.

Ordain—to specially set apart for the Christian ministry by a religious ceremony.

Order—a group of persons united in a society, sometimes under a vow.

Organ—a part of the body which has a special function—way of making known the official acts and opinions of an organization.

Organic—chemistry which deals with carbon compounds as are found in living things.

Organic disease—one in which there are changes or injury in the structure of an organ which results in symptoms.

Organism—anything which has life (often used to refer to micro-organisms).

Origin—beginning, source.

Oxidize—breaking down or burning of substances by combining with oxygen.

P

Pagan—worshipper of idols.

Palatable—with a good taste.

Parasites—organisms which live upon or within other living organisms.

Passive immunity—immunity produced in the body of an animal or man and injected as serum into a human being. The body has no active part in producing it.

Pasteurization—process of destroying harmful organisms in milk or other foods by heating to 60°C—65°C for half an hour and then cooling rapidly.

Pasteur treatment—a series of 12-14 injections of small amounts of rabies virus-containing spinal cords from infected animals. This is used for immunizing a person or animal against rabies after having been bitten or infected by a rabid animal.

Pathogen—organism which causes disease.

Pathogenic—disease producing.

Pathological—diseased.

Patriotism—loyalty and love of one's country.

Peasant—farm labourer, man of low social rank.

Penance—self punishment in sorrow for sins.

Penetrate—to reach the inside of, pierce, enter.

Peritonitis—inflammation of the peritoneum, the membranous lining of the abdominal cavity.

Permanent—lasting.

Pernicious anaemia—a very severe form of anaemia in which there are gastro-intestinal and nervous symptoms as well as muscular weakness.

Persecution—state of being injustly treated and punished for religious faith.

Petri dish—flat glass dish with loose fitting cover in which bacteria are grown on a solid medium.

pH—in chemistry the symbol for hydrogen ion of acidity. Pure water (neutral) is 7.0.

Phagocytosis—a process by which white blood cells, especially polymorphonuclear leukocytes, surround bacteria and destroy them.

Philanthropic—kind and loving, with concern for others.

Philanthropist—one who uses his wealth and sometimes his time and efforts for the benefit of others.

Physiotherapy—treatment with heat, light, water, electricity, massage, exercise, etc.

Pigment—colouring matter, dye.

Pipette—narrow glass tube, with both ends open, used for transferring and measuring liquids, like a medicine dropper.

Poach—to simmer in water or liquid.

Politician—one who is concerned first of all with matters of civil government.

Politics—affairs related to government.

Polydipsia—excessive thirst.

Polyneuritis—inflammation of nerves, more than two usually being involved.

Polyphagia—eating too much at a time.

Polysaccharide—a carbohydrate made of many units of simple sugar.

Polyuria—excessive secretion of urine.

Pore—a very small hole or opening between particles of the mass.

Portal of entry—pathway by which micro-organisms enter the body.

Portal of exit—pathway by which micro-organisms leave the body.

Precaution—special care taken before time to prevent bad results.

Precede—go before.

Precision—accuracy, exactness.

Prejudice—an unreasoning rejection or dislike, partiality.

Primitive—from early times and therefore very simple and uncivilized.

Property—quality or characteristic.

Prophylactic—preventive.

Proportion—relative amount, part.

Prosperity—success, good fortune.

Protein—a nutrient, the main substance of which the animal body is made, the basis of muscle, bone, cartilage, skin, hair, nails. It is made of amino acids.

Protestants—those who took part in the Reformation, protesting against the wrong practices of the church.

Protozoa—the largest classification of micro-organisms belonging to the animal kingdom.

Pruritis—itching.

Puerperal fever—an infection which develops after child-birth if cleanliness is not maintained.

Pulmonary—of the lungs.

Pureed—mashed and strained.

Pustule—raised portion of skin containing pus.

Putrifaction—action of bacteria to break-down protein.

Q

Quarantine—isolation of a person with a communicable disease.

R

Rabid—affected with rabies.
Racial immunity—natural immunity of one race to certain diseases.
Radiation—passing of energy through space.
Rancid—having a spoiled smell (used about fat).
Reaction—(of blood)—acidity or alkalinity.
Readily—easily.
Refine—to make pure, to polish.
Reformation—a religious revolt against feudalism and against the doctrines and practices of the church of that day—The Roman Catholic Church.
Regard—to consider or think of.
Registration—keeping an official record of qualified nurses.
Regulate—to control.
Release—to give out, to free.
Remedy—medicine or treatment used to cure a disease.
Renaissance—a period of the revival of learning, art and culture.
Reproduce—to produce young.
Reproduction—multiplying by bearing children or young.
Requirements—needs.
Residual—remaining after a part has been removed, as indigestible fibre remaining after digestion and absorption of food.
Residue—remainder, as after absorption of food in intestines.
Resist—to oppose or work against unfavourable conditions.
Resistance—power to fight against an enemy, or against unfavourable conditions.
Resistant—having power to resist or fight unfavourable conditions.
Restore—to bring back to normal condition.
Restrict—limit.
Retention—holding back.
Retina—inner sensitive lining of the eye which receives the images in sight, therefore the part of the eye that sees.
Rickets—a children's disease in which bones are soft and become curved and deformed.
Rickettsiae—very small micro-organisms which can grow only on living tissue
Roast—to bake in hot fat in the oven, i.e., to cook partly in hot fat and partly in hot air.
Rotate—to move around in a circular movement.
Roughage—indigestible fibre.

S

Sanction—authorize, confirm, approve.
Saprophytes—organisms which feed on dead material.
Satiety—ability to satisfy.
Scarlet fever—an acute infectious disease in which the patient has a bright red skin rash and sore throat.
Seclusion—separation, in privacy.

Secretion—process by glands of separating from the blood certain materials from which a new useful substance is made, the substance so secreted.

Secular—not religious, wordly.

Sedentary—sitting.

Sedimentation—process by which suspended particles in a liquid settle to the bottom carrying bacteria with them.

Sepsis—presence of pathogenic organisms.

Septicemia—a generalized inflammation affecting the whole body and caused by the absorption into the blood of infectious material containing micro-organisms, spreading them throughout the body.

Schick test—a skin test to determine immunity to diphtheria.

Serological test—a test to study the reaction, between serum of a patient, antibodies and antigens.

Serum—watery portion of the blood after coagulation.

Serum sickness—a mild, delayed reaction to the injection of foreign protein. Symptoms may be chill, nausea, omiting, skin rash.

Significance—meaning, importance.

Simmer—to cook food slowly below boiling temperature about 84°C.

Site—place, spot.

Situate—to locate, place.

Slant—an agar culture in a test-tube which has hardened on a slant and used to grow bacteria.

Slender—narrow, thin.

Society—people in general as living in relationship to one another.

Solidify—become solid.

Soluble—can be dissolved, i.e., changed to liquid form.

Solution—a preparation made by dissolving a substance in a liquid : a mixture of liquids or of solids and liquids.

Solvent—a liquid which will dissolve another substance.

Source—place from which a thing is gotten, its beginning.

Spare—to save.

Spastic—having excessive contractions in long spasms.

Species—a group of organisms with certain common characteristics, a kind of variety.

Species immunity—immunity of members of one species to diseases of another species.

Specific dynamic action of food—stimulating effect of food on basal metabolism causing increased production of energy as heat.

Spore—a collection of protoplasm of a bacterial cell into a small mass with resistant covering which can live in very unfavourable circumstances for a long time.

Stability—ability to remain unchanged, without being destroyed.

Stable—not easily changed or broken down into its elements.

Stagnation—not flowing.

Stale—old, beginning to spoil.

Standard—an example accepted as correct.

Steam—to cook food in vapour from boiling water.

Sterility—loss of power to reproduce : condition of being free from germs.

Sterilization—the complete removal or destruction of all organisms both pathogenic and non-pathogenic.

Sterol—complex substance obtained from fats.

Stew—to simmer food slowly with only a little liquid in a covered pan.

Stimulate—cause an increase of activity.

Stock—water in which vegetables, bones or meat have been simmered slowly for a long time.

Stomatitis—inflammation of the mouth.

Store—to collect and keep for safe keeping or for future use.

Stress—to place emphasis on.

Structure—form or arrangement of parts.

Substance—material.

Succour—to help.

Sufficient—enough.

Supplement—to add something to.

Suppress—put down, check or stop.

Survive—stay alive, remain alive longer than another.

Susceptible—easily affected, sensitive.

Suspend—to hand or float.

Suspension—act of hanging or floating ; a fluid containing particles hanging in it.

Synthesize—to combine separate, elements to form a new substance, to manufacture.

T

Tension—pressure or strain.

Term—word.

Theoretical—having to do with the study of the science of something as different from the practice or doing of it.

Therapeutic—curative, for treatment of. disease, healing.

Tolerate—to be able to take without any harmful effects.

Toxin—poison, especially bacterial poison.

Toxoid—modified toxins used to produce active immunity.

Transmission—passing or spreading from one to another.

Transmit—to pass or spread from one to another.

Trephine—to cut a circular hole with a saw.

U

Ultra microscopic—too small to be seen under the ordinary microscope.

Uraemia—symptoms of renal failure in which there is an upset in the acid-base equilibrium and salt-water balance in the body.

V

Vaccine—a suspension of dead or weakened bacteria or of killed or weakened virus, which is injected into the body to stimulate antibody formation.

Varices—dilated veins.
Varieties—kinds.
Varying—differing.
Vector—one who carries pathogenic micro-organisms, especially used when referring to animals.
Vegetative form—the form of bacteria which can grow and multiply as distinguished from spore-form.
Venereal—relating to sexual contact, therefore diseases transmitted by sexual contact.
Vermin—harmful small animals and insects such as bedbugs, flies, lice, fleas mice, rats, etc.
Vesicle—a blister or raised portion of skin, containing fluid.
Vestments—gowns worn by priests in special religious services.
Veteran—former soldier who has been active in war time in the past.
Virulence—the power of organisms to produce disease.
Virus—the smallest of micro-organisms which can pass through a filter and cannot be seen by ordinary microscopes.
Vital—essential for life, of great importance.
Volatile—easily evaporated.
Volunteer—one who gives service of his own free will, usually without pay.

W

Wasting—breaking down of body tissue by disease resulting in loss of weight
Widal test—an agglutination test for typhoid fever.

Y

Yeasts—single celled plants, much larger than bacteria.

Z

Zeal—enthusiasm.

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